AN INVENTORY OF THE SPRING CREEKS IN MONTANA

By

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ABSTRACT

An inventory of the spring creeks in the state of Montana was conducted in 1985. A total of 68 spring creeks were visited during the project's duration. A site visit to each inventoried creek included an analysis of channel and physical characteristics, riparian zone health and species composition and land use practices. Existing physical, chemical and biological data were later gathered from state and federal agencies and private consultant groups and non-profit orginizations. The majority of the creeks were located in the southwest region of the state in the Beaverhead, Madison, Jefferson , Yellowstone, upper Missouri and Gallatin River drainages. Poindexter Slough is the only spring creek in the state purchased to protect the resource. The remainder are in private ownership and access is usually restricted or allowed with a trespass fee. Major land use activities along the creeks were generally agriculturally related, including cattle grazing and hay production. Waters from the creeks have been diverted for irrigation and augmented by river flows. In general, Montana's spring creeks are being severely abused and their fishery potential is currently not being met. Management recommendations were included for each creek.

ACKNOWLEDGEMENTS

An inventory of this nature is not possible without the help of many individuals. Personnel from the Montana Department of Fish, Wildlife and Parks contributed countless hours to the project's completion. George Holton's interest in Montana's spring creeks led to invaluable assistance in the collection of existing data. Ron Marcoux's initiation of a spring creek inventory in 1979 contributed insights from a statewide perspective. Department fisheries biologists and managers contributed extensively to the collection of data and information in their management areas. US Forest Service and Bureau of Land Management fisheries biologists were also contacted in the initial inquiries concerning spring creek location.

Thanks are extended to the entire Region 3 fisheries staff who hold 70% of the spring creeks within their region. Site inventories in this region would not have been possible without the assistance of Chris Clancy, Fred Nelson, Dick Oswald and Bruce Rehwinkel. Dick Vincent, Fred Nelson and Chris Clancy reviewed the manuscript. Their interest in the project is greatly appreciated.

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INTRODUCTION

Spring fed streams are a unique and rare ecosystem, offering a combination of productive waters with relatively constant temperatures and flows. They provide very uniform conditions in areas which are subject to great seasonal changes (Hynes 1970). They may be inhabited by relect species of former times which have survived, protected from the cold winters or warm summers, as the case may be. Although the number of species may be restricted because of the uniformity of the temperature, total biomass and growth usually far exceeds surface streams in the area. In Montana, several spring creeks have gained national recognition as a result of their uniqueness.

An inventory of the major spring creeks in Montana was completed in 1985. No major survey of this resource has previously been conducted. An informal questionaire was circulated in 1979 by Montana Department Fish, Wildlife and Parks (MDFWP) fisheries personnel (R. Marcoux, pers.comm.). Information was requested on the major spring creeks by region. Less than 30 creeks were listed. Berg (1975), in part of a larger study, investigated several spring creeks in the upper Yellowstone drainage. Clancy (1984 and 1985) continued and expanded the spring creek inventory in the Yellowstone, emphasizing mainstem spawner use. Several spring creeks in the Madison and East Gallatin River drainages have been included in MDFWP instream flow requests (MDFWP 1979 and 1981).

The majority of Montana's spring creeks originate in valley bottoms and are relatively short in length. Major land activities in the valleys are agriculturally based, including livestock and crop production. Most of the creeks have been integrated into irrigation and grazing systems with their courses altered, their riparian habitat grazed and their flows diverted for irrigation or augmented by river water.

The MDFWP fisheries database and an inventory of geothermal sites (MBMG 1981) were used to gather initial spring creek data and location for the inventory (Appendix C). Additional information was gathered from fisheries managers and biologists in state and federal agencies and private conservation and consulting groups. Due to budget constraints, the inventory was limited to spring creeks with flows greater than 5 cfs(Appendix D). Smaller creeks were only included if they were locally or regionally important. Creeks where surface flow contributed more than 50% of the creek's annual flow were also deleted.

Spring creek inspections began in May. The opportunity for public access on a creek usually determined the extent of the inspection. If public access was restricted, the inspection was confined to a road crossing(s) or other public access point. In

situations where either landowner permission was obtained or public access was unrestricted, the entire length of stream or reaches of the stream were walked. The channel inspection included a temperature measurement, channel width and depth measurement, an estimation of flow, a visual substrate composition analysis and aquatic macrophyte abundance. The riparian zone inventory consisted of determining riparian health, species composition and percent bank cover. Land use was recorded and the effect of that activity on stream habitat was noted.

Upon the completion of site inspections, compilation of existing biological, chemical and physical data for each creek occurred. MDFWP regional and state headquarters files were examined for information on spring creeks. Dingell-Johnson progress reports from 1950 to 1985, MDFWP fisherman logs and the fisheries database were reviewed for any available spring creek data. Files from the Water Quality Bureau, the US Geological Service (USGS) and non-profit orginizations involved in land conservation programs were investigated for data. Flow information was collected from USGS files from 1910 to the present. Private individuals were contacted to obtain data on spring creeks on their property. Legal descriptions, channel length and land ownership were obtained from Bureau of Land Management 1:100000 maps. Legal descriptions were described by Township, Range, Section and quarter or quarter-quarter section. Quarter sections were described from A to D with A being the NE 1/4, B being the NW1/4, C the SW1/4 and D the SE1/4. All distance and size measurements were recorded in British Units. Fish species were cited by their common names(Appendix B).

The final spring creek narrative included a general description with location, land use and physical measurements, a habitat trends and limiting factors section and a fisheries and other biological data summary. The final section, potential value and management recommendations, included an evaluation of the potential of the creek as a resident fishery or its importance to the drainage. The management recommendations were a combination of a subjective evaluation and input from MDFWP area fisheries biologists.

A volume of photographs of the inventoried spring creeks is on file at the Fisheries Division office of the Montana Department of Fish, Wildlife and Parks in Helena, Montana.

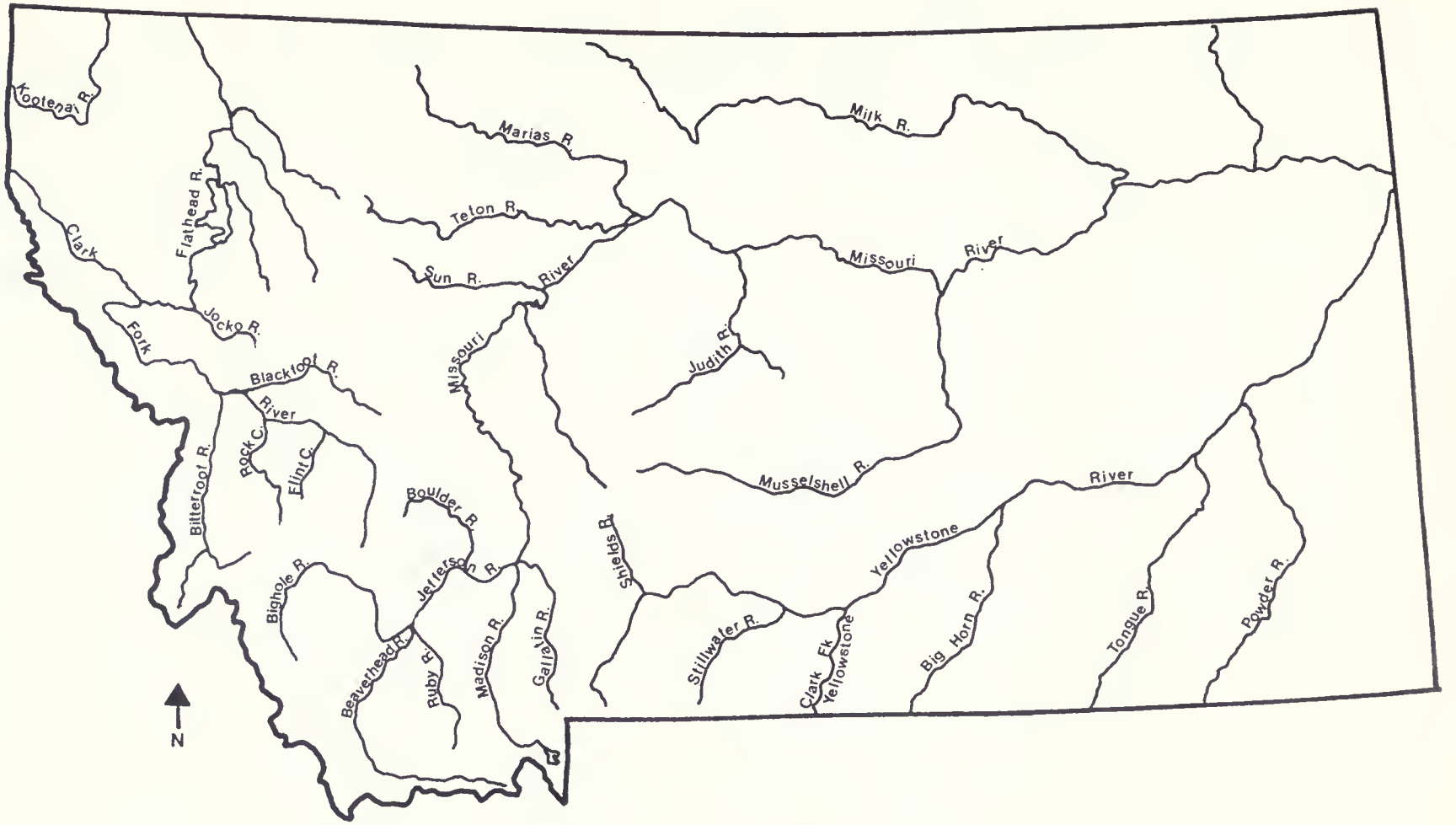

Figure 1. Map of the State of Montana with the major river drainages.

COLUMBIA RIVER DRAINAGE

STANLEY CREEK

Region: 1 Water Code: 11-6480 Database Code: 985
Legal Description: Origin: T29N, R34W, Section 35BD
Mouth: T29N, R34W, Section 13BA
County: Lincoln

General Description

Stanley Creek flows in a southerly direction for 4.8 miles before entering Lake Creek at river mile 13.8. Lake Creek is a tributary to the Kootenai River entering at mile 187.0. Stanley Creek flows entirely on the Kootenai National Forest,allowing for public access along its entire course. There are two tributaries in the drainage, Thicket Creek at river mile 1.8 and Fairview Creek at river mile 2.7. The springs that feed Stanley Creek are considered to be the underground outlet of Spar Lake (Domrose 1973). Spar Lake is located 1.5 miles above the springs in the drainage. Major land uses in the drainage are timber harvest and mining. A silver mine producing 60,000 tons of copper-silver concentrate annually, was opened in 1981 by ASARCO in the Stanley Creek drainage (USFS AND DSL 1978).

Stanley Creek ranges in width from 10 to 40 feet with a mean depth of 12 inches. Flows were measured by the USGS and the Department of State Lands in 1977 (USFS AND DSL 1978). A flow of 171 cfs was measured in May of 1977 indicating surface runoff affecting flow in Stanley Creek on a seasonal basis. Base flow during the period of record was 33 cfs. Water quality was also measured prior to the mine opening (USFS and DSL 1978)(Appendix A). Stanley Creek water is soft, alkaline and calcium-bicarbonate in character with low concentrations of dissolved minerals and nutrients. Turbidity and total suspended solids are low and did not show a significant increase during runoff. Water parameter levels did not exhibit the high fertility usually observed in valley origin spring creeks. Water temperatures during 1977 ranged from 42 to 64. ^{o} (5.$^{\backprime}$ to 18^{o}C). The substrate composition is a clean/gravel mixture free of sediment accumulation.

The riparian zone of Stanley Creek is in excellent condition. The canopy species include cedar, willow, alder, grasses and forbs. Deeply undercut banks and considerable debris from timber harvest add to instream cover.

Habitat Trend and Limiting Factors

The fisheries habitat in Stanley Creek will remain in a static condition if no major problems occur as a result of timber harvest and mining in the drainage. Logging in the drainage could

affect suspended sediment levels and instream and bank cover if incorrectly done. Monitoring of groundwater quality is occurring to detect quality changes resulting from the mining operation. Limiting factors in the creek are generally natural. The water is cold and relatively infertile with a fairly steep gradient.

Fisheries

Fish sampling occurred in 1977 to document baseline conditions prior to the mining operation (USFS AND DSL 1978). Brook trout, westslope cutthroat and cutthroat/rainbow hybrids were the game species surveyed. Slimy sculpin was the only nongame species found. Stanley Creek is also used by Lake Creek trout as a spawning tributary.

A population estimated of 281 brook trout weighing 8.9 pounds was obtained from a 1,000 ft section in Stanley Creek (USFS and DSL 1978). Age structure was normal with 66% of the population I+ and the remainder 2+ and older. Growth was considered slow.

Potential Value and Management Recommendations

The fisheries potential of Stanley Creek is probably currently being met. The water is cold, low in dissolved nutrients and the gradient is fairly steep. Monitoring of the surface and groundwater qulaity in the drainage should continue to be monitored to insure no changes from the mining operation.

FLATHEAD RIVER DRAINAGE

Figure 2. Flathead drainage map.

FLATHEAD RIVER SPRINGS

Numerous springs arise in the upper Flathead River drainage, flowing for short distances before entering the river. The springs are located between Flathead Lake and the mouth of the South Fork of the Flathead River. Two additional spring creeks are located in the Middle Fork of the Flathead River. These springs are located in Flathead County.

The springs below the South Fork Flathead River are affected on a seasonal basis by either the operation of Kerr Dam on the outlet of Flathead Lake,the operation of Hungry Horse Dam on the South Fork of the Flathead River or natural spring runoff. These springs have been inventoried to determine spawner use by Flathead Lake kokanee salmon. Resident fisheries have not been surveyed in most of these springs.

Beaver Creek parallels the Middle Fork Flathead River for less than 1 mile before entering the river at mile 13.4. One landowner owns the entire stream and access is restricted to the public. Land use along the creek includes cattle grazing and irrigated hay fields. The channel is used by the Middle Fork during spring runoff. Major channel alterations have occurred to the creek,reducing total length (M.Gaub, pers.comm.). Flows ranging from 35 to 42 cfs were measured in 1983 (Fraley 1984). Water temperature ranged from 37 to 45^{o}F(2 to 7^{o}C) from November 1978 to May 1979 (J.Fraley,pers. comm). Spawning kokanee salmon use the stream annually. Brook, westslope cutthroat, rainbow and bull trout have been surveyed in the creek.

Pouliott Spring Creek parallels the Middle Fork Flathead River for less than one mile before entering Deerlick Creek, a tributary to the Middle Fork. Two landowners own the creek and access is completely restricted. No cattle grazing or irrigation occur in the drainage. No flow or physical data have been collected on the creek. Water temperatures ranged from 42 to 44 ^{o}F(5 to 6^{o}C) from February to May, 1979 (J. Fraley, pers. comm.). Kokanee salmon were imprinted in the creek from 1979 to 1983 to establish a spawning run. Beaver dams are constructed in the lower channel but spawning activity above the dams have been recorded (M. Gaub, pers. comm.).

Columbia Falls Slough enters the Flathead River at river mile 144.1 after flowing in a southerly direction for .6 mile. The slough is used by the main river during spring runoff as an overflow channel. Flows have not been measured in the Slough. Water temperatures during November, 1983 ranged from 43 to 45 ^{o}F(6 to 7 ^{o}C) (J.Fraley, pers.comm). Kokanee annually use Columbia Falls Slough for spawning. Brook trout and mountain whitefish were also surveyed.

Taylor Spring Creek flows for 2 miles in a southeasterly

direction before entering the river at mile 142.6. Two ponds have been constructed on the channel. The creek was investigated in July, 1982 for consideration as a spawning channel for kokanee salmon. Flow was measured at 21.3 cfs, water temperature was 55°F(13°C) and dissolved oxygen level was 13.3 mg/l (J. Fraley, pers. comm.). The spring creek itself is not used by kokanee but gravels in the river at the creek's mouth are used on an annual basis. One landowner owns the entire creek and uses the adjacent land and the spring for cattle and hay production.

Spring Creek flows in a westerly direction for 1.2 miles before entering the river at mile 134.2. The creek is entirely on private property and land use in the drainage is cattle grazing and hay production. No physical or chemical data have been collected on Spring Creek. Kokanee salmon use the main river below the mouth of Spring Creek. The creek is blocked to upstream migration by numerous beaver dams (M. Gaub, pers. comm.)

Fairview Spring flows for less than .5 mile in a southerly direction before entering the river at mile 132.6. The channel is used by the main river during spring runoff. The origin of the spring is located on an island in the river. Kokanee use the channel for spawning. No physical or chemical data have been collected on Fairview Spring.

Lybeck Spring flows in a southerly direction for less than .5 mile before entering the river at mile 132.0. The creek is affected by the operation of Hungry Horse Dam and much of the gravels are dry at a normal winter flow (Fraley and Graham 1982). The cobble/gravel substrate is generally covered by a layer of fine sediment. A flow of 13 cfs was recorded in November, 1979. Kokanee use the channel for spawning.

Brenneman's Slough flows in a southeasterly direction for 1.5 miles before entering the river at mile 125.2. The slough is affected by the operation of Kerr Dam from April to November. Flathead River water backs up into the lower channel, inundating the lower mile of slough. Flows have been measured on an annual basis and range from 7 to 11 cfs (Fraley and Graham 1982). Water temperatures range from 39 to 51°F (4 to 12°C) from April to November. The substrate is composed of a gravel/cobble mixture covered by a thick layer of fine sediment. Kokanee salmon use the slough for spawning. Mountain whitefish and rainbow and cutthroat trout were also surveyed. Major land use in the drainage include cattle grazing and crop production.

Siderius Slough flows in a southerly direction for less than 2 miles before entering Brenneman Slough. Kokanee salmon have only been observed using the stream during one year. Westslope cutthroat and brook trout have also been surveyed(Region 1 files).

SPRING CREEK

Region: 1 Water Code: 07-4280 Database Code: AAU
Legal Description: Origin: T29N, R21W, Section 11CB
Mouth: T29N, R21W, Section 03BC
County: Flathead

General Description

Spring Creek flows for approximately 6 miles in a southerly direction before entering the Stillwater River at river mile 2.6 near Kalispell, Montana. Trumbull Creek is the only tributary in the drainage entering at river mile 3.7. The stream is in private ownership except for a 1.5 mile section located in the Stillwater State Game Preserve. Lands adjacent to the creek are used for residential and agricultural purposes.

The channel of Spring Creek is 6 to 20 feet wide with a mean depth of 12 inches. The channel in the lower 3 miles is a series of riffles and runs with limited pool development. The substrate composition is a cobble/gravel mixture with fines accumulating in the pools. The riparian zone is in excellent condition. Species composition includes willow, alder, grasses and forbs. Velocity is reduced in the upper 3 miles above Trumbull Creek. Fines have accumulated in much of the channel. The riparian zone consists of grasses and forbs. Clumps of cattails and willows are also present. A flow of 10 cfs was measured by the USGS on Spring Creek in 1951 near mile 5. Water temperature in September was recorded at 54^{O}F(12 ^{O}C).

Habitat Trend and Limiting Factors

The fisheries habitat of Spring Creek has deteriorated substantially as a result of agricultural and residential practises. Numerous stream crossing s using culverts have restricted the natural flow. Pools have been formed as a result. Residential domestic sewage may be polluting the creek. Numerous houses outside the city spetic system have been constructed along the banks. Domestic livestock and irrigation have degraded the habitat and dewatered the channel.

Fisheries

Brook trout and rainbow trout are the game species present in Spring Creek. Mottled sculpin are the only nongame species surveyed. The population was estimated at 116 trout per 1,000 feet in 1977 (B.Domrose, pers.comm.). Mean length was 8.7 inches.

Potential Value and Management Recommendations

A survey of the existing fisheries population and habitat should be conducted on Spring Creek to inventory current conditions. Because of the numerous and varied land uses in the drainage, the problems affecting Spring Creek are complex.

MILL CREEK

Region: 1 Water Code: 07-2820 Database Code: A7C
Legal Description: Origin: T28N, R20W, Section 10DD
Mouth: T28N, R20W, Section 27BB
County: Flathead

General Description

Mill Creek flows in a southwesterly direction for 4.1 miles before entering the Flathead River at mile 112.5 near Creston, Montana. Blaine Creek, the outlet to Lake Blaine, is the only tributary in the drainage, entering at river mile 1.7. The creek originates in Jessup Mill Pond located on USFWS property. The Creston Fish Hatchery is located on this property and diverts approximately 95% of the flow for the hatchery operation before returning it to the stream. The remainder of the drainage is divided between at least 5 private landowners. Major land use in the drainage is cattle and horse grazing and crop production. Several residential houses are also located on the banks. Access is restricted throughout the entire length. Hunting rights are leased on the lower 1 mile of stream. Highway 35 crosses Mill Creek near river mile 3.0.

Flows were measured by the USGS in 1960 at several locations. Above and below the hatchery, the flows were measured at 27.6 and 43.7 cfs, respectively. A flow of 32 cfs was measured in October, 1985 below the Highway 35 bridge (B. Domrose,pers.comm). Annual water temperatures range from 38 to 52°F(3 to 11°C) with a mean temperature of 46°F(7°C) (T. Pruitt, pers.comm). Width ranges from 15 to 30 feet with a mean depth of 18 inches. Pool depths exceed 36 inches in many locations. The stream is characterized by a pool/run sequence with intermittent riffles. The gravel/cobble substrate has been covered by fine sediment and abundant aquatic vegetation in much of the channel. The health of the riparian zone varies depending on land use. The upper section on USFWS property is characterized by a dense cover of ponderosa pine, willows, grasses and forbs. Sections heavily grazed by cattle are void of woody species and grasses and forbs are the major species in the zone. A .5 mile section immediately below the highway has been altered extensively for flower landscaping. The riparian zone in the lower 3 miles is in fair to good condition. Clumps of willows and alder are located throughout this section.

Habitat Trend and Limiting Factors

The habitat trend on much of Mill Creek is in a deteriorated state. The property owned by the USFWS is in excellent condition. Depending on individual landowner use of the creek, the habitat varies throughout the stream length. The section below the USFWS

property has been heavily grazed. No woody riparian vegetation is present. Banks are sloughing and raw and the channel has been widened. The section immediately below the highway has been channelized and all bank cover has been removed for flower production. The major limiting factors in the drainage is poor land use practises.

Fisheries

Rainbow, brown and westslope cutthroat trout are the game species that have been surveyed in Mill Creek. No population estimates have been conducted. Department Fisherman Logs from the 1960's showed large numbers of brook trout being caught.

A 500 foot section downstream from the flower gardens was electrofished in October,1985 (B. Domrose, pers.comm.). This section of stream flows through a heavily grazed pasture lacking woody riparian species. A total of 5 game fish were captured including 4 rainbow trout and 1 brook trout. Total length ranged from 3.4 to 7.0 inches. Mottled sculpins were also captured.

Potential Value and Management Recommendations

Mill Creek has the potential of becoming an outstanding spring creek fishery. Water quality is excellent, flow and temperature are constant and in areas where grazing has not occurred, habitat is of high quality. Fisheries and habitat surveys should be conducted on Mill Creek to document existing conditions. The fisheries potential of Mill Creek is currently restricted as a result of land use practises. Fencing of abused sections could greatly enhance the trout habitat. Limited access to the angling public has discouraged interest in Mill Spring Creek. Inquiries should be conducted to determine potential conservation easements and/or land acquisitions.

As a result of the 1985 stream access bill, a petition was filed by two of the landowners on Mill Creek requesting restriction of public access to their property. The petition was denied by the Montana Fish and Game Commission in December, 1985.

RONAN SPRING CREEK

Region: 1 Water Code:07-4300 Database Code:NA
Legal Description: Origin: T20N, R20W, Section 14DB
Mouth: T21N, R19W, Section 08CA
County: Lake

General Description

Ronan Spring Creek flows in a southeasterly direction for 9 miles before entering Crow Creek at river mile 11.5 below the town of Ronan, Montana. Crow Creek is a tributary to the lower Flathead River, entering at river mile 41.5. Ronan Spring Creek is located on the Confederated Salish-Kootenai Indian Reservation. The majority of the creek and its adjacent land (76%) has been leased to non-tribal members. The remainder is used by tribal members for private use. Only 4% of the creek is considered "public" where use is unrestricted to Tribal members. Non-tribal members must obtain a tribal recreational permit to fish the creek. A major landowner on the creek conducted an extensive study in 1982 to document current habitat and fisheries condition (Stream Team 1982). Management recommendations to improve the fishery on his property were also provided. Major land uses in the drainage are cattle and crop production. Approximately 1 mile of the creek runs through the town of Ronan and is used as a city park.

Ronan Spring Creek originates from a series of springs located in a depression in a hay field. Width of the channel ranges from 10 to 30 feet with a mean depth of 18 inches. Pools formed in areas of channel constrictions range up to 36 inches deep. A USGS gauging station was located on Ronan Spring Creek from 1974 to 1977. Flows ranged from 19.7 to 32.3 cfs with a mean flow of 25.0 cfs. Water temperatures were measured during 1975 in conjunction with a valley wide study (Morrison and Mailre 1977). Temperatures ranged from 55 to 63^{o}F (12 to 17^{o}C). The substrate composition is characterized by a gravel/cobble mixture covered by a heavy accumulation of fine sediment. Only in areas below channel constrictions are the gravels exposed. Aquatic plants are numerous throughout the channel during the summer months. Specific water quality parameters were measured in 1976 and 1977 above and below the town of Ronan (Morrison and Mailre 1977). Levels of constituents were generally comparable except for total coliform. These levels were elevated well above state water quality standards below the town of Ronan.

The riparian zone of Ronan Spring Creek is limited to grasses and forbs along much of the length of the creek. Where woody species are present, species include willow, cottonwood, elderberry, water birch, sedges, rushes and grasses.

Habitat Trend and Limiting Factors

The general trend in fisheries habitat of Ronan Spring Creek is in a deteriorated condition. Cattle grazing within the riparian zone has caused bank sloughing, a widening of the channel, sediment deposition and a loss of woody species. The city of Ronan's urban storm system discharges into the creek.

Fisheries

Fisheries surveys have been conducted on Ronan Spring Creek since 1965 (Domrose 1971,Peterson 1976 USFWS 1979 and Randall 1980). Brook and rainbow trout and mountain whitefish are the game species that have been inventoried. Nongame species have included longnose dace, largescale and longnose sucker and redside shiner. Population estimates were conducted on three sections in 1982 (J. Darling, pers. comm). In a section 1.5 miles above the town of Ronan, 1421 brook trout and 259 rainbow trout were estimated in a 1,000 ft section. Size ranges of brook and rainbow trout were 3.9 to 11.6 inches. This section of stream was fenced and no grazing was allowed along the banks. An estimate .5 miles above Ronan calculated 504 brook trout and 62 rainbow trout in a 1,000 ft section. Total length ranged from 4.1 to 10.8 inches and 5.7 to 13.7 inches for brook and rainbow trout, respectively. This section was not fenced and seasonal grazing did occur along the stream banks. A 1,000 ft section directly above the town of Ronan was the third section electrofished. The trout population was estimated at 211 brook trout ranging from 4.5 to 11.3 inches and 23 rainbow trout ranging in length from 6.0 to 13.8 inches. This section was not fenced and banks were open. The variation in population between these three sections was considered to be a result of habitat differences as a result of land use practices (J. Darling, pers. comm.). A reach near the mouth was electrofished in the summer of 1985 (G.Thomas, pers. comm.). Redside shiner, longnose dace and longnose and common sucker were the only species collected in the 500 ft section. No game species were collected in the section.

Potential Value and Management Recommendations

Fencing of Ronan Spring Creek would greatly enhance the fishery habitat. Drop structures throughout the channel would create clean substrate, increasing spawning gravels. The section of creek running through the town of Ronan should be returned to a more natural state.

SCHALL (VALLEY) SPRING CREEK

Region: 1 Water Code: 07-4840 Database Code:NA
Legal Description: Origin: T17N, R20W, Section 35AD
Mouth: T17N, R20W, Section 17AB
County: Lake

General Description

Schall Spring Creek flows for approximately 5 miles in an easterly direction before entering the Jocko River at mile 11.5. LaMoose Creek is the only tributary in the drainage, entering at river mile 3.2. The flow of LaMoose Creek is relatively small and does not affect Schall Creek flow on an annual basis. The creek is located entirely on the Confederated Salish-Kootenai Indian Reservation. The majority of the creek (84.4%) is leased by non-tribal members. The remainder is used by tribal members for private activities. Major land use in the drainage is cattle and crop production. The channel is used to transport irrigation water. There are approximately 6 landowners in the drainage. Access is restricted but granted by permission by some of the landowners.

Schall Spring Creek arises from a series of springs in a low wooded area in the Jocko Valley. Channel width ranges from 4 to 15 feet with a mean depth of 10 inches. Flows were measured by the USGS sporadically beginning in 1909. Flows ranged from 11.1 to 16.8 cfs. Flows up to 41.5 cfs have been recorded during the irrigation season when water is being ported through Schall Creek (G. Thomas, pers. comm.). Stream morphology is characterized by a riffle/run sequence meandering across the Jocko Valley. Pools are infrequent. The substrate composition is a gravel/cobble mixture but covered by an accumulation of fine sediment throughout much of the channel. Where gravels are clean, the substrate is armoured. Water temperature at the time of the site visit in June was 53°F (11 °C). The riparian zone is patchy throughout the channel depending on land use. The lower section, below Highway 93, was characterized by increased willow cover although much is in a decadent state. Above the highway, woody plants are less common and grasses and forbs are the dominant species in the riparian zone. Velocity is slow throughout except for a short channelized section paralleling the highway and railroad.

Habitat Trend and Limiting Factors

The fisheries habitat in Schall Spring Creek is in a deteriorated condition throughout much of the channel. Cattle grazing has eliminated bank cover, widened and shallowed the channel reducing instream cover and fines accumulation have

occurred in runs and pools. Banks are sloughing in the lower section below the highway. The channel is in a braided condition at the mouth to the Jocko River. Use of the creek for irrigation water transport creates turbid conditions throughout the growing season.

Fisheries

Numerous electrofishing surveys have been conducted on Schall Spring Creek since 1969 (Domrose 1971,Peterson 1976, USFWS 1979, Randall 1980 and G. Thomas, pers. comm.). Game species surveyed include rainbow, brook and brown trout and mountain whitefish. Nongame species surveyed include mottled sculpin and sucker species. The USFWS have been responsible for the management of Schall Spring Creek. Stocking of catchable rainbow trout occurred until 1982. Spawning mountain whitefish migrating from the Jocko River have been documented using the channel (USFWS 1979).

A population estimate was conducted on a section of Schall Spring Creek located near the mouth in September, 1985(G. Thomas, pers. comm.). The estimate indicated brown trout were the dominant game fish, followed by mountain whitefish and rainbow trout. Although an estimate was obtained, confidence intervals were larger than the point estimates and therefore, are not included in this discussion. Mean length of brown trout, whitefish and rainbow trout were 4.9 inches, 6.8 inches and 4.7 inches, respectively.

Potential Value and Management Recommendations

Agricultural practises on Schall Spring Creek have severely degraded the fisheries habitat. Fencing and using stock water access gaps could greatly enhance the creek's trout habitat. Alternative routes for the transportation of irrigation water could reduced turbidity, sediment deposition and channel armouring.

CLARK FORK RIVER DRAINAGE

Figure 3. Clark Fork River drainage.

LITTLE BLACKFOOT SPRING CREEK

Region: 2 Water Code: NA Database Code:NA
Legal Description: Origin: T10N, R07W, Section 13DC
Mouth: T10N, R07W, Section 33BC
County: Powell

General Description

Little Blackfoot Spring Creek flows in a southwesterly direction for 3 miles before entering the Little Blackfoot River between the towns of Avon and Elliston, Montana. The creek is owned by one landowner and access is restricted. Land use along the creek is limited to cattle grazing and an occasional hay field. Stream flow was estimated at 6 to 10 cfs at the time of the site visit in October. Water temperature was 58°F(14°C). The channel is 15 to 30 feet wide with a mean depth of 8 inches. The upper 2.5 miles of creek are characterized by a run/riffle sequence. Substrate composition consists of a clean cobble/gravel substrate covered by clumps of watercress, other aquatic macrophytes and benthic algae. The riparian zone is in poor condition in this upper section, severely degraded by cattle grazing. There are no woody plants on the left bank and less than 30% of the right bank is covered. Many of these plants are decadent and provide no overhanging cover. Species composition in the riparian zone includes willow, grasses and forbs. The lower .5 miles of creek is inundated by beaver dams and riparian health increases in this area. Velocity is greatly reduced in this section and fines have accumulated in the channel.

Habitat Trend and Limiting Factors

The fisheries habitat in Little Blackfoot Spring Creek is in a deteriorated condition. Cattle grazing has destroyed the riparian zone, widened the channel and caused severe bank slumping. Channel width has been artificially increased from 10 feet to 15 to 30 feet. Depth is greatly reduced and instream cover is lacking. Beaver dams on the lower channel have altered the riffle/run nature of the stream and blocked 90% of the channel in some areas.

Fisheries

No fisheries data have been collected on Little Blackfoot Spring Creek. Migration of spawning trout from the Little Blackfoot would be restricted as a result of the beaver dams in the lower channel.

Potential Value and Management Recommendations

A fisheries and habitat survey should be conducted on Little Blackfoot Spring Creek to document existing conditions. Fencing of Little Blackfoot Spring Creek from cattle grazing would greatly enhance the trout habitat. The potential exists for a high quality resident trout population if the stream could be narrowed and instream and bank cover allowed to develop. Removal of the beaver dams on the lower channel would enhance the population of the Little Blackfoot River through increased spawning gravels.

WARM SPRINGS CREEK

Region: 2 Water Code:06-6878 Database Code:C17
Legal Description: Origin: T10N, R 9W , Section 5B
Mouth: T09N, R10W, Section 15BB
County: Powell

General Description

Warm Springs Creek flows in a southeasterly direction for 9 miles before entering the Clark Fork River at river mile 440.5 near Garrison, Montana. There is one tributary in the drainage located at river mile 4.4. A 150 foot falls is located at mile 6.0. Numerous spring seeps are also located in the falls area. Land ownership in the drainage includes 5% by the Bureau of Land Management, 5% by the State of Montana and the remaining 90% in private landholdings. Land activities in the drainage include grazing, hay production, mining and recreation. A phosphate mine owned by the Comico Company of Canada is located in the drainage at river mile 8. The lower drainage and creek is used for cattle grazing, stock water and hay production. Access is restricted on the mine property and is granted by permission from most of the landowners on the lower section.

Channel width ranges from 6 to 15 feet with a mean depth of 12 inches. Depth in pools exceed 2 feet. A flow of 10.2 cfs was measured near the mouth by the USGS in 1972. A temperature of 67°F(19°C) was measured at the time of the site visit in October. The substrate composition in the upper 5 miles of channel is a clean gravel/cobble mixture with thick beds of watercress. Riparian health is excellent and species composition includes willow, alder,grasses, forbs and conifers. The lower 2 miles of channel have been abused severely by cattle grazing. The substrate has been covered by a layer of fine sediment. Riparian zone health is poor and only 30% of the banks are covered by woody species. Numerous beaver dams have inundated the lower .5 mile of stream. Stream morphology at the mouth is restricted to pools up to 4 feet deep.

Habitat Trend and Limiting Factors

The lower 2 miles of Warm Springs Creek is in a deteriorated condition as a result of agricultural abuse. The channel is used extensively for stock water and much of the woody riparian zone has been removed by grazing. Bank sloughing and channel instability is apparent throughout the lower section. The stream flows through a small feedlot located approximately 2 miles from the mouth. Beaver dams have restricted spawner access from the Clark Fork River.

Fisheries

The warm temperature of Warm Springs Creek severely restricts the resident trout population. An electrofishing survey was conducted in 1982 in the lower mile of stream (R. Spoon, pers. comm.). Brown trout were common in the section and longnose sucker were abundant.

Spawner use from the Clark Fork River has not been documented.

Potential Value and Management Recommendations

Removal of the beaver dams at the mouth of Warm Springs Creek could encourage spawning from the Clark Fork River. Fencing of the lower two miles would significantly improve the current deteriorated condition of this section. An instream flow reservation should be filed on the creek.

STUART MILL CREEK

Region: 2 Water Code:06-6365 Database Code:NA
Legal Description: Origin: T05N, R13W, Section 19DD
Mouth: T05N, R13W, Section 19DD
County: Granite

General Description

Stuart Mill Creek flows in an southerly direction for approximately .5 mile before entering Georgetown Lake east of Denton Point. Georgetown Lake is located 20 miles west of Anaconda, Montana. It is a reservoir on Flint Creek constructed in the late 1890`s for power generation and irrigation. It is a popular recreation area, supporting the 4th highest lake fishing pressure in Montana (MDFG 1976). Land use in the Stuart Mill drainage is residential with one landowner on the stream. Historically, Stuart Mill Creek was used for electric generation to mill gold in the early 1900's. Today, the water wheel, the old cement dam and power house still remain on the creek approximately 200 yards above its mouth. Access is granted by permission from the landowner.

Stuart Mill Creek is 7 to 15 feet wide with a mean depth of 6 inches. The gradient is fairly steep, maintaining a clean gravel/cobble substrate. Stream morphology is limited to runs and riffles with depth not usually exceeding 12 inches. The flow at the time of the site visit in August was estimated at 10 to 12 cfs. Water temperature was 43^{o}F(6 ^{o}C). The riparian zone is in excellent condition and forms a canopy over the entire stream. Species composition include lodgepole pine, willow, alder, grasses and forbs. Channel stability is excellent with no evidence of sloughing banks or channel scour.

Habitat Trend and Limiting Factor

The fisheries habitat of Stuart Mill Creek is limited by natural factors. Cold water temperatures, lack of depth and pools and a steep gradient contribute to the lack of suitable trout habitat. The dam and waterwheel currently limit fish access to the upper channel.

Fisheries

No resident fishery has been documented in Stuart Mill Creek. The creek is a critical spawning area for Georgetown Lake kokanee and brook trout (Vashro 1977, 1980 and 1982). The majority of kokanee in Georgetown Lake spawn in either Stuart Mill Creek or two lake shoreline areas. Kokanee escapement has not been

documented.

Potential Value and Management Recommendations

Use of Stuart Mill Creek as a spawning area could be greatly expanded if the dam and waterwheel were removed. Current kokanee management in Georgetown Lake,however, is concentrating on reducing the number of kokanee to increase size. An instream flow reservation should be filed on Stuart Mill Creek to protect this important spawning tributary to Georgetown Lake.

NEVADA SPRING CREEK

Region: 2 Water Code: NA Database Code:NA
Legal Description: Origin: T13N, R11W, Section 11D
Mouth: T13N, R11W, Section 9C
County: Powell

Nevada Spring Creek meanders across the Nevada Creek valley for approximately 3 miles before entering the creek at mile 11.0 near the town of Helmville, Montana. There are two landowners on the spring creek and the upper landowner owns the majority of the creek. Access is restricted and limited to family and friends. Cattle grazing and hay production are the major land activites in the drainage. Nevada Spring Creek receives irrigation return and is part of an irrigation system. Its entire length is used for stock water and grazing. The headwaters of the springs flows through a feedlot.

The channel is 8 to 25 feet wide with a mean depth of 12 inches. Depth in pools range up to 4 feet. The flow was estimated at 10 to 12 cfs at the time of the site visit in early October. Stream morphology is restricted to slow moving runs with an occasional riffle and pool. The gravel/cobble substrate has been covered by a thick layer of fine sediment. The riparian zone consists of grasses and forbs. All woody species have been removed by cattle grazing. Severe bank sloughing has occurred throughout the channel. Most banks are raw and exposed.

An electrofishing survey on Nevada Spring Creek was conducted during the summer of 1984 (W. Hadley,pers.comm.). Because of equipment difficulties and depth of the pools, the survey could not be completed. Several sucker species and redside shiners were collected.

The MDFWP area biologist has been working with the upper landowner to obtain some form of protection for this spring creek. The entire channel should be fenced from cattle use. Stream structures would create a diversity of habitat in the channel. Willows and other woody species should be planted to reestablish a riparian zone.

NORTH FORK BLACKFOOT
SPRING CREEK COMPLEX

Region: 2 County: Powell

ROCK CREEK
Legal Description: Origin: T15N, R11W, Section 26DD
Mouth: T14N, R11W, Section 06AD

KLIENDSCHMIDT CREEK
Legal Description: Origin: T14N, R11W, Section 03BD
Mouth: T14N, R11W, Section 07AC

LOST CREEK
Legal Description: Origin: T15N, R11W, Section 33BD
Mouth: T15N, R11W, Section 32CB

General Description

Three spring creeks flow into the North Fork of the Blackfoot River between river miles 9.9 and 11.0 near the town of Ovando, Montana. Kliendschmidt Spring Creek converges with Rock Creek 300 yards above its confluence with the North Fork at river mile 9.0. Both streams are approximately 3 miles in length. Lost Creek flows for approximately 1.5 miles before entering the North Fork at river mile 11.0. One landowner owns the entire lengths of Lost and Rock Creeks, including their spring origins. Three landowners own Kliendschmidt Creek, two which own the majority of the creek. Access to all three streams is acquired by permission from the landowners. Land uses in the three drainages include cattle grazing and hay production. Water is diverted from the three creeks for irrigation. Water from Rock Creek was used for commercial trout production from 1977 to 1982. Ten raceways were constructed to raise 200,000 12-14 inch rainbow trout on an annual basis. The majority of Rock Creek was diverted through the raceways.

A stream flow of 22.0 cfs was measured on Rock Creek at the time of the construction of the hatchery. Kliendschmidt and Lost creeks flows have been estimated at 15 to 17 cfs and 10 cfs, respectively. Water temperatures were measured at 58 ^{o}F (14.4^{o}C). Stream morphology in these three creeks is similar, restricted to run/riffle sequences. Width varies from 6 to 20 feet with mean depths of 6 to 8 inches. The substrate in Rock and Lost creeks is a gravel/cobble mixture free of fine sediment accumulation. Kliendschmidt Creek's velocity is slower, creating more runs and accumulation of fines is apparent throughout most of the upper channel. Velocity increases in the lower .5 mile and the gravel/cobble substrate is exposed. There is no woody riparian zone on either Lost or Rock creeks and only on the lower .5 mile of Kliendschmidt Creek. Grasses and forbs are the dominant

riparian species on all three creeks. Lower Kliendschmidt Creek's riparian zone consists of alder, willow, lodgepole pine and grasses and forbs.

Habitat Trend and Limiting Factors

The fisheries habitat in the three North Fork Blackfoot Spring creeks has deteriorated substantially as a result of cattle grazing. Woody riparian species are completely lacking. The channels have been widened and depths reduced. Banks are raw and slumping throughout the channels. Irrigation dewaters all three streams during the summer months.

Fisheries

Rock Creek below the convergence with Kliendschmidt Creek was snorkeled during September, 1985 by the MDFWP Region 2 Staff. Thirteen brown trout ranging in length from 15 to 24 inches and 11 rainbow trout ranging in length from 14 to 18 inches were observed in the large pool formed directly below the Hyway 200 bridge. These fish were felt to be residents of the North Fork Blackfoot River. The lower 200 yards of Kliendschmidt Creek were snorkeled at the same time and no trout were observed in this section.

No fisheries data have been collected on Lost Creek.

Potential Value and Management Recommendations

Considerable fisheries habitat improvement would occur on Kliendschmidt and Rock creeks if cattle were fenced from the stream banks. At this time, lack of bank and instream cover prevents these spring creeks from meeting their fisheries potential. Depth is lacking and essentially no riparian zone is present. Both of these streams have substantial flows and could become productive bodies of water. Lost Creek could also be improved significantly with fencing but should be given a lower priority than Rock or Kliendschmidt creeks.

BEAVERHEAD RIVER DRAINAGE

Figure 4. Beaverhead River drainage.

BEAVERHEAD RIVER SLOUGH COMPLEX

Numerous "sloughs" occur in the floodplain between the Beaverhead and Big Hole Rivers below Dillon, Montana. Although some anglers and biologists alike consider these sloughs to be spring creeks, the source of the water cannot be traced to one major spring or a series of springs. It is my opinion that these slough channels are abandoned Beaverhead River channels or high water channels that are no longer used by the river and have filled with groundwater. The river may still flow through a section of these sloughs before it reconnects with the river. Although important fisheries in their own right and by some definitions spring creeks, these streams will not be addressed in this inventory.

Included in this list of sloughs are Albers, Schoolhouse, Owsley, Stodden, Selway, California and Third Slough.

CLARK CANYON RESERVOIR SPRINGS

Region: 3 Water Code: NA Database Code: NA
Legal Description: Origin: T10S, R10W, Section 29
Mouth: T10S, R10W, Section 29

General Description

Three springs flow in a northerly direction for relatively short distances before entering Clark Canyon Reservoir near the Red Rock River. Two of these springs parallel the access road to the north end of the reservoir and run for approximately .5 mile when the reservoir is at full pool. These springs each flow an estimated 3 to 5 cfs. Water temperature was 52°F (11°C) at the time of the site visit in August. The two channels are fairly similar in structure, ranging in width from 5 to 20 feet with a mean depth of 8 inches. Stream morphology is characterized by a riffle/ run sequence. Substrate composition consists of a cobble/gravel mixture with fines accumulating where velocity is reduced. Clumps of aquatic macrophytes are present throughout the channel and are the only instream cover present. Riparian vegetation species are restricted to non-woody species. Forbs and grasses are the dominant species. Because of the slope of the banks, the vegetation that is present does not contribute to bank cover.

The third spring channel flowing into the Clark Canyon Reservoir is located west of the Red Rock River. It flows for approximately 1.5 miles before entering the reservoir. Much of the channel has the appearance of being altered or manmade. The source is a series of springs in a marshy area in the valley. Flow was estimated at 3 to 5 cfs. Water temperature at the time of the site visit in August was 54°F (12 °C). Width of the channel ranged from 3 to 10 feet with a mean depth of 8 inches. A riffle-run sequence characterized the channel. Substrate was a cobble/gravel mixture with fines covering over 80% of the channel. Riparian health was excellent with 60% of bank cover composed of woody species. Grasses and forbs comprised the remaining riparian vegetation.

No fisheries data have been collected on these three springs. Spawning by Clark Canyon Reservoir brown trout have been observed but use has been unquantified. These springs were investigated for their potential as spawning channels for reservoir trout. With a change in the MDFWP rainbow stocking program to a strain capable of spawning in the wild, additional spawning area may be necessary. Water quality is excellent in all three channels and flows are relatively constant. Major limitations in their present condition are public accessibility, lack of instream and overhead cover, and lack of adequate velocity

to maintain clean substrate. With channel improvement structures increasing the gradient, gravel placement and construction of cover structures, these three channels could provide extensive and high quality spawning habitat for Clark Canyon Reservoir trout.

GORDON SPRINGS

Region: 3 Water Code: NA Database Code:NA
Legal Description: Origin: T09S, R10W, Section 30B
Mouth: T09S, R10W, Section 32C
County: Beaverhead

A site visit to Gordon Springs did not occur during the current spring creek inventory. Its existence was learned of through flow records in Helena in October. The fisheries biologist in Dillon took photographs of the springs in December and therefore, Gordon Springs will be included in this inventory.

Gordon Springs flow in a southeasterly direction for approximately 2 miles before entering the Beaverhead River approximately .5 mile below Clark Canyon Dam. Landownership is private and major land use in the drainage is agricultural. Flows were measured by the USGS during the period of 1964 to 1976. Flow ranged from 16.2 to 35.7 cfs. No pattern in the flow fluctuations were apparent. Water temperatures were recorded during 1966 and 1967 (R. Kennedy, pers. comm.). Temperatures were constant at 56°(13 °C). Brown and rainbow trout have been observed spawning in the Beaverhead River below the mouth of the springs (D. Oswald, pers. comm.).

A fisheries and habitat survey should be conducted on Gordon Springs to document existing conditions. An instream flow reservation should be filed on the springs.

McMENOMEY SPRINGS

Region: 3 Water Code:NA Database Code:NA
Legal Description: Origin: T09S, R10W, Section 29A
Mouth: Same as origin
County: Beaverhead

General Description

McMenomey Springs are located approximately 1 mile below the Clark Canyon Dam. Flow is in a northeasterly direction for less than one mile before entering the Beaverhead River. The springs are located entirely on private property and access totally restricted. The springs emerge from a cluster of low limestone cliffs. There are two major springs with numerous smaller springs emerging along the base of the cliffs.

Flows were collected by the USGS in the mid 60's prior to the construction of Clark Canyon Dam. From February to August, 1965, flows varied from 19.4 to 24.9 cfs. Water temperatures were measured from 1965 to 1967 (R. Kennedy, pers.comm.). Temperatures ranged from 66 to 70°F(18 to21 °C). Water chemistry data were collected in 1981 and exhibited high quality and fertility (MBMG 1981). Dense mats of watercress are abundant throughout the channel.

The channel is poorly defined except for the lower .25 mile. Its flow is restricted by a weir at the mouth and a pool is formed as a result of this constriction. The lower channel is characterized by depths up to 12 inches and a channel width of 4 to 10 feet. The riparian zone consists of willow, alder, grasses and forbs. It is patchy throughout the channel. The west side channel of the Beaverhead River receives the majority of its flow from the springs. This channel is used extensively by spawning rainbow and brown trout (D. Oswald, pers. comm.). Spawning occurs earlier in this channel as a result of the higher water temperature of the springs . Trout have not been documented using the spring channel proper. Access is unlikely due to a weir located at the mouth. No resident fisheries data have been collected on the springs.

POINDEXTER SLOUGH

Region: 3 Water Code: 01-9320 Database Code: AJS
Legal Description: Origin: T08S, R09W, Section 15 A
Mouth: T07S, R09W, Section 26 B
County: Beaverhead

General Description

Poindexter Slough flows in a northwesterly direction for 4.2 miles before entering the Beaverhead River south of the town of Dillon, Montana. This creek is the only spring creek in the state that has public ownership for the majority of its length. In 1980, with the help of the Nature Conservancy, the Department of Fish, Wildlife and Parks purchased a 440 acre cattle ranch in the Beaverhead floodplain that included the lower 2 miles of Poindexter Slough. An additional land trade was made in 1981 which included another .5 mile of the spring creek. The area has been minimally developed by the Department to allow for parking. The Department's management plan for the lands are to provide and protect the spring creek fishery, manage for waterfowl and upland game birds and manage the area for dispersed walk-in recreational use.

The remainder of the slough is owned by private individuals. The landowner immediately upstream from the state property manages the property for its fisheries values. The two larger springs that contribute to Poindexter Slough are located on his property. The headwater area is used for cattle production. Access is restricted except for the state owned property.

The Dillon Canal Company holds the majority of the water rights on Poindexter Slough. A headgate was constructed on Poindexter in the 1930's to allow Beaverhead River water to flow into the Slough during irrigation season (J. Wells, pers. comm.). Although the natural flow of the springs is approximately 30 cfs, flows up to 100 cfs are not uncommon during the irrigation season (Peterson 1973). Three irrigation claims were purchased by the Department with the land sale. In addition to irrigation claims on the springs, the Department also owns 6 cfs of Beaverhead River water that can be diverted into Poindexter Slough.

Channel width of the Slough ranges from 10 to 40 feet with a mean width of 33 feet (Elser and Wipperman 1971). Deep pools,up to 4 feet in depth, are common along its course. The remainder of the channel is characterized by riffles and runs with a gravel/cobble substrate. Over 60% of the substrate is covered by fine silts and clumps of aquatic macrophytes. The riparian zone has improved since state acquisition of the land with a species composition of willow, alder, grasses, rose and forbs. The majority of the banks have overhanging cover and undercut banks.

The upper state portion is not recovering at the same rate as the lower section. Banks are open and woody riparian species are lacking. Cattle continue to graze illegally on a seasonal basis in this area.

Habitat Trend and Limiting Factors

The habitat of Poindexter Slough continues to improve with the recent changes in land use. Grazing continues to occur in the headwater area creating sediment deposition throughout the channel. An increase in sprinkler use for irrigation instead of subirrigation may be decreasing the groundwater flow to the Slough. The continued use of Poindexter Slough as an irrigation canal is the major limiting factor. The effects of shuttling Beaverhead River water through the slough has had an undocumented effect on fish population dynamics.

Fisheries

The sport fishery of Poindexter Slough consists of brown, rainbow and brook trout and mountain whitefish. Nongame species surveyed in the Slough include longnose, common and mountain sucker, longnose dace and mottled sculpin. Spawning trout from the Beaverhead River have been observed although to what extent has not been documented.

Population estimates using a mark and recapture technique have been conducted on the Slough on a frequent basis since 1969 (Wipperman and Elser 1971, Peterson 1973, Wells 1980 and D. Oswald pers. comm.). Comparing a 1967 estimate with a 1981 estimate, numbers of rainbow and brown trout have increased but mostly in the younger age class (Table 1). This may indicate greater spawner use by the Beaverhead River population.

Since 1982, there has been a considerable decline in the number of rainbow trout in Poindexter Slough. The decline has generally occurred in the younger year classes. The 1985 estimate is showing a slow rebuilding of the rainbow population. No explanation for the decline or its subsequent increase has been determined.

Table 1. Population estimates of brown and rainbow trout in Poindexter Slough in 1967,1981 and 1984. For comparitive purposes all estimates have been converted to 1,000 ft sections(Wipperman and Elser 1971 and D.Oswald,pers.comm.) .

Year	Species	Length Groups		
		6-10.4"	>10.5"	Total
1971	Brown trout	152	120	272
	Rainbow trout	124	59	183
1981		6.5-8.9"	>9.0	Total
	Brown trout	42	283	325
	Rainbow trout	37	37	74
1984	Brown trout	5.0-18.7" 672		
	Rainbow trout	12.0-19.1" 32		

Potential Value and Management Recommendations

Cattle grazing in the headwater area causing increased sediment production and irrigation withdrawl are the major limiting factors to Poindexter Slough. Acquisition of spring irrigation claims should occur when the opportunities arise. The longterm effect of Beaverhead River water on the Poindexter Slough trout population should be investigated if this practice is to continue in the future.

SILVER SPRINGS

Region: 3 Water Code: NA Database Code:NA
Legal Description: Origin: T05S, R05W, Section 14C
Mouth: T05S, R05W, Section 14B
County: Madison

General Description

Silver Springs meanders across the Ruby Valley in a easterly direction for less than one mile before entering the Ruby River at mile 22.6 near the town of Sheridan, Montana. The entire spring is privately owned by two ranches. The springs and the adjacent land are used for stock water, cattle grazing and irrigation. A commercial trout hatchery was developed on the springs in the early 1980's for a short time.

The source is one large spring bubbling out of the ground at the base of a small limestone cliff. Flows were measured near the mouth by the USGS in the 1940's. Flows ranged from 19.1 to 29.8 cfs for two dates in August. The fluctuation may have been a result of irrigation withdrawl. The flow at the time of the site visit in August of 1985 was estimated at 25 to 30 cfs. There is a large irrigation diversion immediately below the source.

Channel width ranged from 10 to 30 ft with a mean depth of 12 inches. The channel morphology is characterized by a low gradient meandering across the valley. A gravel/cobble substrate is covered almost entirely by aquatic vegetation and fine sediments. The riparian zone is in poor condition with woody species found only near the mouth.

Habitat Trends and Limiting Factors

Overuse by cattle has severely reduced the quality of fisheries habitat in Silver Springs. Silt is generated at the source as a result of stock watering. The entire channel has been widened and is dewatered during the growing season from irrigation withdrawl.

Fisheries

Limited fisheries data have been collected on Silver Springs. One electrofishing pass near the mouth occurred in May, 1979 (J.Wells, pers. comm.). Sixteen brown trout were found ranging in length from 5.3 to 14.9 inches. The mouth of the channel is open to allow spawning from the Ruby River to occur. No spawning from the mainstem has been documented, however.

Potential Value and Management Recommendations

The potential value of Silver Springs to the Ruby River mainstem and as a resident sport fishery is essentially limitless. With approximately 30 cfs bubbling out of the ground at a constant temperature near 50°F year round, the water quality and quantity of the lower Ruby River could be greatly enhanced if the entire flow of Silver Springs was to reach the river. Dewatering of the mainstem is an annual problem in the lower Ruby. In 1985, sections of the river completely dried up. The Ruby's potential as a sport fishery has also been depressed as a result of excessive sediment bedload. The clear, high quality water of Silver Springs could enhance water quality conditions of the mainstem. Spawning from the mainstem in Silver Springs could contribute substantially to the population.

A survey of the fisheries and habitat conditions of Silver Springs should be conducted to document current status. An instream flow reservation should be filed on the Springs. Landowners should be approached to assess interest in conservation easements or fencing of the creek and the source if funding were available.

LOTTS SPRING CREEK

Region: 3 Water Code: NA Database Code:NA
Legal Description: Origin: T03S, R06W, Section 34A
Mouth: T03S, R06W, Section 27
County: Madison

General Description

Lott's Spring Creek flows in a northerly direction for approximately 2 miles before entering the Ruby River near the town of Twin Bridges, Montana. One landowner owns the entire drainage. Flow was estimated at less than 2 cfs at the time of the site visit in August. Land use is limited to cattle grazing and hay production. Current recreational use on the spring creek is restricted to a children's fishery. Channel width ranges from 2 to 8 feet with a mean depth of 6 inches. Water temperature at the time of the site visit in August was 62°F(16°C) and measured at 54°(12°C) in June (J.Shouse, pers. comm.). Channel morphology was restricted to long slow runs. Substrate composition was 100% fines and scattered clumps of aquatic macrophytes. Woody riparian vegetation was completely lacking and grasses and cattails were the major species observed.

Habitat Trend and Limiting Factors

Lott's Spring Creek is in a deteriorating condition. Excessive bank slumping has been caused by overuse by cattle. The channel is cleared out periodically with a backhoe to prevent aquatic plant build up. Natural limiting factors include low gradient and velocity.

Fisheries

During the summer of 1985, a small section of Lott's Spring Creek was electrofished (J.Shouse, pers. comm.). Brook trout were found with a length range of 2 to 12 inches. Mottled sculpin were the only nongame species surveyed.

Potential Value and Management Recommendations

The potential value of Lott's Spring Creek to the Ruby River trout population as a spawning area or contributing a major residential sport fishery to the local area is severely limited. Interest in the spring creek has been generated for the use of the creek as a children's fishery.

MINOR SPRINGS IN THE BEAVERHEAD DRAINAGE

There are two warm springs in the Beaverhead River drainage located south of Dillon, Montana, originating on the east side of the river. Brown's Spring cascades from cliffs above the river and flows in a 300 yard channel before entering the Beaverhead. The springs were discussed in the Lewis and Clark journals. Trout potential is limited as a result of water temperatures of 70°F(21 °C). The landowner raises goldfish in ponds filled by diverted spring waters. A flow of 6 cfs was measured by the Montana Bureau of Mines (1981) and water quality data were collected (Appendix A).

Lovell's Warm Springs is located in the foothills of the Blacktail Range east of the Beaverhead River. Water temperatures range from 67 to 72°F(19 to 22 °C)(MBMG 1981). The spring has been damned and is used in the East Bench Irrigation System. The channel from the reservoir to the irrigation canal has been artificially constructed. A flow of 6.6 cfs was measured in 1981 by the MBMG. Because of the high temperatures and the dam, fisheries potential is severely limited in Lovell's Springs. Goldfish and carp were observed on the day of the site visit in August,1985.

Two creeks in the Beaverhead drainage, one located in the Ruby River drainage and the other in the lower Red Rock drainage, have major springs in their drainages. Over 50% of their flow is received from surface water.

Warm Springs Creek, located in the upper Ruby River drainage,is a mountain stream affected by warm springs approximately 3 miles above it mouth. These springs contributed approximately 25% of the stream's base flow. The springs have an impact on the stream's water temperature and fishery. Water temperatures recorded in the winter months were 69 to 70°(20 to21 °C)(N.Peterson,pers.comm.). The water temperatures have limited trout production but have allowed a unique fishery to develop. Noturus flavus, the stonecat, is a small member of the catfish family. Its naturally present throughout the Missouri and Yellowstone River drainages and managed to get over the Great Falls on the Missouri (Brown 1971). Warm Springs Creek is the only stream it has been located above the falls. Warm Springs Creek major value to the Ruby River is an increase in water quality as a result of the low erosive nature and high water quality of the drainage.

Big Sheep Creek, a major tributary of the Red Rock River, has a base flow of 35.0 cfs. Approximately 35% of the flow originates from springs located approximately 8 miles above the mouth. The effects of the springs on the creek has been one of increased water quality and an increase in size and number of trout within and below the spring section(J. Wells, pers.comm.). The land where the springs are located have recently been

purchased by a group of lawyers from Bozeman specifically for their value to the fishery of the creek.

JEFFERSON RIVER DRAINAGE

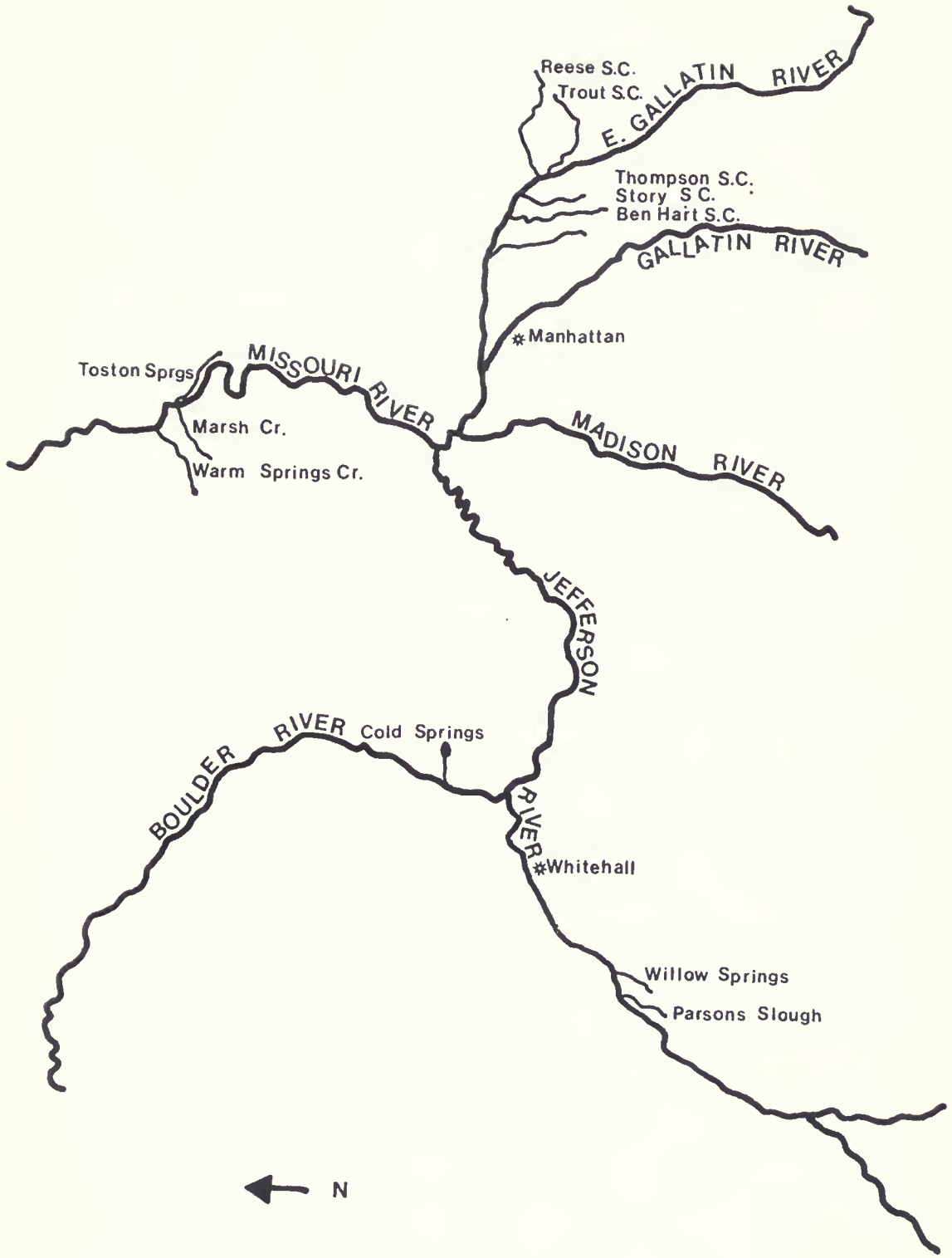

Figure 5. Jefferson River Drainage, upper Missouri River Drainage and E. Gallatin River Drainage.

PARSON'S SLOUGH

Region: 3	Water Code: NA	Database Code:NA
Legal Description:	Origin:T01S,R05W,Section 34BA	
	Mouth: T01S,R05W,Section 14C	
	County:Madison	

General Description

Parson's Slough flows in an easterly direction for approximately 4 miles before entering the Jefferson River near the town of Waterloo, Montana. The land adjacent to Parson's Slough is currently used for cattle grazing and hay production. The stream is owned by one landowner but two landowners control the water rights. Access to the stream is limited to friends and family of the landowner. The channel is uniform in width and has a nonmeandering nature, giving it the appearance of a large irrigation ditch. Width ranges between 20 to 30 feet with a depth range of 1 to 3 feet. Velocity is extremely low with the majority of the channel being a run. A constricting culvert under the county road decreases velocity further. Flow was estimated at 15 to 18 cfs and water temperature was 58°F(14°C)in August, 1985. The substrate is a mixture of gravel/cobble with the majority covered by sediment and aquatic vegetation.

Cattails, grasses, forbs and clumps of willow contribute to the riparian zone of Parson's Slough. Approximately 50% of the stream banks have woody species in the riparian zone with the remainder of the bank being open due to cattle use. Instream cover consists of large mats of aquatic macrophytes.

Habitat Trend and Limiting Factors

The agricultural land use in the valley continues to degrade the habitat of Parson's Slough. Banks are open, the channel is dewatered and macrophytic growth reduce the velocity.

Fisheries

No fisheries data have been collected on Parson's Slough. It is not known if Jefferson River trout use the Slough as spawning habitat.

Potential Value and Management Recommendations

A fisheries survey should be conducted on Parson's Slough to document resident population status and Jefferson River trout use. Removal of cattle from the riparian zone would cause considerable narrowing of the channel over time, but habitat improvement structures would be needed to create diversity.

WILLOW SPRINGS

Region: 3 Water Code: NA Database Code:NA
Legal Description: Origin: T01S, R05W, Section 15AC
Mouth: T01S, R05W, Section 24B
County: Madison

General Description

Willow Springs, a tributary to the Jefferson River, flows for approximately 3 miles in an easterly direction before entering the river near Waterloo, Montana. Land uses in the Jefferson Valley are limited almost entirely to cattle grazing and hay production. Currently, one landowner owns the entire length of Willow Springs and access to stream use is restricted to family and friends. Flow in Willow Springs was estimated at 20 cfs in August, 1985. Water temperature at the source was 52°(11°C). The spring's source originates from a low area in a hay field. An irrigation withdrawl system is located at the source. Width of the upper one mile of channel is 8 to 20 feet with a mean depth of 6 inches. Pool/run/riffle percentages in this section are 5,60 and 30%. Substrate composition is gravel/cobble but silt has accumulated over much of the substrate. The lower channel is 10 to 40 feet wide with a mean depth of 18 inches. Irrigation return and leakage from the Parrot Ditch enter the lower section. Instream morphology in this section is composed of 20% pool, 60% run and 20% riffle. Substrate is a clean gravel/cobble mixture with numerous clumps of aquatic plants. Fines have accumulated in the deeper pools and runs.

The riparian zone of Willow Springs is composed of willow, alder, grasses, sedges and forbs. Cattle use in the upper section have left the banks open and raw. The lower section has excellent bank cover with woody species lining the majority of the stream. Fencing has kept the cattle from much of this lower section.

Habitat Trend and Limiting Factors

Cattle use in the riparian zone of upper Willow Springs continues to deteriorate habitat quality. Instream and bank cover are completely lacking. Irrigation withdrawl in the upper section has further depleted the amount of instream cover. The effect on water quality from irrigation return in the lower section is unquantified.

Fisheries

A two pass population estimate was made on the upper section in 1982 by a Montana State University class (R. White, pers.comm.). Brown trout, rainbow trout,brook trout and mountain whitefish were found in the section.

Potential Value and Management Recommendations

The rainbow trout population of the upper Jefferson River is currently limited due to lack of suitable spawning habitat (B. Rehwinkel,pers.comm.). Spawner use has been documented in only one creek in the drainage. It is not known if Jefferson River trout are currently using Willow Springs. An inventory of use and access to the stream is recommended.

During the fall of 1985, the landowner on Willow Springs was approached to discuss habitat protection (B.Rehwinkel, pers.comm.). A "gentlemen's agreement" has been established to improve the fishery by allowing catch and release fishing only and fencing the stream banks from cattle use. Renewable Resource money from the state has been approved for use on Willow Springs to fence the creek, install water gaps and construct drop structures to increase diversity. The Butte Trout Unlimited Chapter has volunteered their time to work on the project. Work will begin during the summer of 1986.

COLD SPRINGS CREEK

Region: 3 Water Code:NA Database Code: NA
Legal Description: Origin: T02N,R02W,Section 06D
Mouth: Same as origin
County: Jefferson

General Description

Cold Springs flows into the Boulder River from a northwesterly direction approximately 1 mile northeast of the town of Whitehall, Montana. One landowner owns the entire springs and its channel. Two landowners have water rights to the springs and use it seasonally for irrigation. Cattle grazing only occurs in the drainage during the winter months. Cold Springs has a total length of less than 1 mile. It has had substantial channel alterations due to the spring's use for commercial trout production. In 1977, a complex series of ponds, raceways and drainage channels were built to raise rainbow trout for the Jumping Rainbow Ranch. In 1981, commercial production was abandoned and deterioration of the structure has occurred. The springs continue to flow through many of the structures. Public access to Cold Springs is by permission from the landowner.

Two channels enter the Boulder River with an estimated flow of 40 to 50 cfs. Water temperature in August was 54°F(12°C). The channels are 6 to 15 feet wide with a depth range of 6 to 18 inches. Substrate composition is a cobble/gravel mixture free of sediment accumulation. Riparian species consisted of willow, alder, grasses, forbs and sedges and bank cover was provided by these species to approximately 50% of both channels. Instream cover in the form of depth was lacking.

Habitat Trend and Limiting Factors

The fisheries habitat of Cold Springs is currently in a static condition. Because the springs continue to run through the numerous structures developed for commercial fish production, the present condition will remain until the structures are removed and a channel is constructed.

Fisheries

No biological data have been collect on Cold Springs. Brown trout are the only species recorded by anglers. Both channels are clear for upstream migration from the Boulder River. The river below the springs are used by spawning brown trout (B. Rehwinkel, pers. comm.).

Potential Value and Management Recommendations

A fisheries survey should be conducted on Cold Springs to document present resident populations and spawning use. The springs contribute the majority of the flow to the east channel of the Boulder River during the irrigation and winter season (B. Rehwinkel, pers. comm.). The potential of these springs as a resident fishery as well as providing spawning habitat and high water quality and quantity to the Boulder River is substantial. Management needs include removal of all raceway structures and reconstruction of a stream channel and riparian zone. An instream flow reservation should be filed on the stream's water.

EAST GALLATIN RIVER DRAINAGE

EAST GALLATIN SPRING CREEK COMPLEX

A series of streams arise in the Gallatin Valley with similar characteristics. These streams' waters primarily originate from surfacing groundwater created from snowpack in the Bridger and Gallatin Mountain ranges. Irrigation return water augments their flows during the summer months. These streams include Ben Hart, Hess, Gibson, Story, Thompson, Trout (Spring Branch), Bull Run and several minor streams originating in the same manner.

Land use along the East Gallatin is primarily limited to cattle grazing, feedlots and hay and alfalfa production. The entire valley is in private ownership.Access to streams is usually allowed by permission from the landowner. At the present time, there is no formalized habitat protection to any of the streams or their adjacent lands.

Considerable deterioration has occurred from agricultural use to most of the spring creek habitat in the East Gallatin valley. The streambanks are either vegetated with willow, alder, grasses and forbs or open due to intense cattle use. Extensive bank erosion is apparent on many sections of creeks which has widened the stream channel and decreased depth. The majority of the cobble/gravel substrate has been covered with a layer of sediment. In many cases, exposed gravels are cemented and spawning habitat is limited.

Although considerable habitat deterioration has occurred to the spring creeks of the East Gallatin valley, sport fisheries still exist on the streams. These waters are naturally productive with rainbow and brown trout occasionally exceeding two pounds. Spawning use of these creeks from the East Gallatin has not been documented.

Fisheries and habitat surveys should be conducted on all the East Gallatin spring creeks to document exisiting conditions. Based on these surveys, creeks should be prioritized as to which to pursue for habitat protection and enhancement. Management strategies for each creek could than be outlined which could include conservation easements, habitat rehabilitation and other measures necessary to encourage the wise use of these valuable natural resources.

TROUT or SPRING BRANCH CREEK

Region: 3	Water Code: 09-5700	Database Code:NA
Legal Description:	Origin: T01N, R05E, Section 25A	
	Mouth: T01N, R05E, Section 19DA	
	County: Gallatin	

General Description

Trout Creek, or Spring Branch Creek, enters the East Gallatin River at mile 20.5 after flowing in a southeasterly direction for 4 miles. The springs are scattered throughout the length of the stream as it meanders through fertile agricultural land. The channel width ranges from 5 feet in its headwater area to 20 feet near its mouth with a mean depth of 12 inches. The U.S. Bureau of Reclamation measured 5 instantaneous flows on Trout Creek in 1952 and 1953. Flows ranged from 7.7 to 12.0 cfs. Trout Creek has been used by the main river as an overflow channel during spring runoff. This is evidenced by severe bank and bed scour throughout the lower channel. Water quality data collected by Holton (1953) indicated water high in natural productivity. Woody riparian habitat decreases in a downstream direction with the banks near the mouth being completely open as a result of excessive cattle abuse.

Fisheries

Rainbow, brown and brook trout and mountain whitefish were the game species found throughout the length of the stream (Holton 1953). Nongame species include mottled sculpin, sucker sp. and longnose dace. Spawning from the mainstem was indicated by the large number of young-of-the-year trout found in the creek (Holton 1953). Brown trout were found up to 25.5 inches in length. A population estimate conducted using a mark-recapture method found 287 trout per 1,000 ft. Species composition included 72% rainbow, 25% brook trout and 3% brown trout in 1952. Only 3% of the trout were greater than 7 inches. A study was conducted in 1962 and 1963 to compare current trout populations with what was found by Holton (Wipperman 1963). A comparison of physical, chemical and certain biological factors showed little change in the 10 year period. Brook trout were the predominant species in the upper section and rainbow trout were dominant in the lower 3 sections. The total number of all trout species was 22 percent less but total weight was 49 percent more. Brown trout numbers increased with brook and rainbow trout numbers declining.

No further fisheries data have been collected since 1963. Present population status is unknown and is believed to have declined considerably as a result of poor land use practices.

REESE SPRING CREEK

Region: 3 Water Code:09-4826 Database Code:NA
Legal Description: Origin: T02N, R06E, Section 32B
Mouth: T01N, R05E, Section 18A
County: Gallatin

General Description

Reese Spring Creek flows in a southerly direction for less than 4 miles before entering the East Gallatin River near Belgrade, Montana. Channel width ranges from 10-18 feet with a mean depth of 12 inches. Flows were measured by the USGS in 1952 and 1953 near the mouth of the creek. Mean monthly flows ranged from 6.7 to 45.6 cfs during the irrigation season (Hackett et al.1960). Base flow for 1952 was between 5.7 and 7.6 cfs. Stream morphology is dominated by runs with 20% being pool habitat and 10% in riffles. A water temperature of 59°F(15°C) was recorded on the day of the site visit. Suspended sediment and fecal coliform levels were found to exceed state standards (Shouse 1977). Riparian habitat was considered good with over 50% of the banks covered by overhanging woody species. Species composition included willow, grasses and forbs.

Fisheries

Brown trout, rainbow trout, brook trout and mottled sculpins are the fish species present in Reese Spring Creek. Fisheries data collected in 1954 and 1968 using a one pass method, showed brook trout and brown trout to be dominant, respectively. Fish populations in a 1,000 ft section of Reese Spring Creek were surveyed by electrofishing in October of 1980 (Region 3 files). Brown, rainbow and brook trout were the game species captured (Table 1).

Table 1. Summary of electrofishing survey in Reese Spring Creek in a 1,000 ft section located in T01N,R05E, section 10.

Species	No. Captured	Length Range(inches)
Brown Trout	229	3.2-19.1
Rainbow Trout	32	3.3-11.5
Brook Trout	7	4.7-9.8

The standing crop of brown and rainbow trout were estimated using a mark-recapture method. The estimate calculated 548 brown trout and 28 rainbow trout in this 1,000 ft section (Table 2).

Table 2. Estimated standing crop of brown and rainbow trout in a 1,000 ft section of Reese Spring Creek in October, 1980.

Species	Length Group(inches)	Per 1,000 ft. Number	Pounds
Brown Trout	3.2- 5.9	437	
	6.0- 9.9	61	
	10.0-12.9	50	
		548(±163)	60(±9)
Rainbow Trout	4.5-11.5	28(±6)	8(±2)

Reproduction of brown trout appears to be substantial in this section based on the number of smaller size trout.

GIBSON SPRING CREEK

Region: 3 Water Code:NA Database Code:NA
Legal Description: Origin: T01N, R04E, Section 16
Mouth: T01N, R04E, Section 04
County: Gallatin

General Description

Gibson Spring Creek flows for approximately 2 miles before entering the East Gallatin River at river mile 9.3 near the town of Manhattan, Montana. Channel width ranges from 6 to 15 feet with a mean depth of 10 inches. The USGS measured flows in Gibson Spring Creek near the mouth in 1952 and 1953 (Hackett et al 1960). Mean monthly flows ranged from 8.9 to 19.5 cfs with a mean flow for 1952 of 14.8 cfs. Substrate is clean near the mouth of the creek as a result of an increase in stream gradient. The remainder of the channel has an accumulation of fines over much of the gravel/cobble substrate. The riparian zone contains willow, alder, overhanging grasses and forbs. Over 50% of the bank contains woody species near the mouth. Lands along the upstream reaches are badly overgrazed and woody vegetation is scarce.

Fisheries

No fisheries or other biological data have been collected on Gibson Spring Creek. Angler data indicated the presence of rainbow and brown trout.

THOMPSON SPRING CREEK

Region: 3 Water Code: 09-6346 Database Code:AON, AOM
Legal Description: Origin: T01N, R05E, Section 32 CC
Mouth: T01N, R04E, Section 13 DA
County: Gallatin

General Description

Thompson Spring Creek flows in a southwesterly direction for 6.8 miles before entering the East Gallatin River at river mile 18.6 near town of Belgrade, Montana. There are at least 6 landowners in the drainage with a dairy farm located in the headwater area. A 400 acre ranch bordering 2.9 miles of the creek was subdivided into 20-30 acre tracts for homesite construction.

Beginning in late 1978, prior to any subdivision of land, the Madison-Gallatin Chapter of Trout Unlimited and the Gallatin Wildlife Association requested the Montana State Legislature and the Fish and Game Commission purchase 285 acres of this proposed subdivided land. In their arguements to the Commission, they cited clean water flowing into the E. Gallatin, preservation of a dwindling resource(i.e.,spring creeks) and protection of fish spawning grounds as reasons for the purchase. In March, 1979, the Department denied the purchase based on factors including high cost, the priority need to protect the headwater area,an existing heavy sediment deposition problem, low fish populations, the need for habitat rehabilitation and conflicting ownership within the acquisition area.

Habitat is reported to be improving on a portion of the creek that has been fenced in recent years to exclude livestock from the stream banks(F.Nelson, pers.comm.).

The width of Thompson Spring Creek's channel ranges from 15 to 30 feet with a mean depth of 12 inches. In 1952 and 1953, flows were measured near the mouth by the USGS(Hackett et al. 1960). The flows ranged from 25.5 to 40.1 cfs. Highest flows were from April through October. Ten percent of the gravel/cobble substrate is exposed. The remainder is covered with sediment 0.1 to 2.0 ft thick and aquatic plants (DFG 1979).

Fisheries

In a 1975 survey, rainbow and brown trout were common in Thompson Spring Creek. Brook trout were less abundant. Tiger trout have been reported by anglers in Thompson Spring Creek. Nongame species include longnose dace and mottled sculpin. Spawning from the East Gallatin has not been documented however,

Thompson Spring Creek is clear to the river.

Population estimates calculated on a 1,000 ft section were conducted in 1968 and 1975 on Thompson Spring Creek. In 1968, 552 trout were found with a species composition of 54% brown trout,40% rainbow trout and 6% brook trout. By 1975, total number of trout in a 1,000 ft section was 362, or 65% of the total found 10 years earlier. Considerable habitat deterioration occurred during this time period (D. Vincent, pers.comm.).

STORY SPRING CREEK

Region: 3 Water Code: 09-6080 Database Code:NA
Legal Description: Origin: T01S, R04E, Section 11DB
Mouth: T01N, R04E, Section 03CA
County: Gallatin

General Description

Story Creek flows for 7.1 miles in a southwesterly direction before entering the East Gallatin River at river mile 10.6 near the town of Belgrade, Montana. A fee of $15.00 has been charged to fish the lower 2.2 miles of the creek. A 4 rod per day limit has been placed on the section.

Channel width ranges from 12 to 20 feet with a mean depth of 12 inches. Flows were measured on Story Creek near the mouth by the USGS in 1952 and 1953 (Hackett et al. 1960). Mean monthly flows ranged from 11.6 to 24.7 cfs. Monthly flows increased during spring runoff and again during the irrigation season. Gradient of the stream decreases near the origin with an increase in flow. The gravel/cobble substrate is more exposed and uncompacted in this creek when compared to the other East Gallatin spring creeks. The water was turbid as a result of irrigation return.

Fisheries

Brown trout and rainbow trout are considered common in Story Creek with an occasional brook trout. Department Fisherman Logs from 1967 to 1980 reveal a catch of these species ranging in length from 8 to 15 inches. Brown trout over 20 inches have also been reported (F. Nelson, pers. comm.).

BEN HART CREEK

Region: 3 Water Code: 09-0304 Database Code: AND
Legal Description: Origin: T01S, R04E, Section 03BD
Mouth: T01N, R04E, Section 04AC
County: Gallatin

General Description

Ben Hart Creek flows 3 miles in a northerly direction before entering the East Gallatin River at river mile 14.3 near the town of Belgrade, Montana. The stream is presently owned by one family with little chance of land purchase at this time (D. Vincent, pers. comm.). The USGS measured flows in Ben Hart Creek from 1951 to 1953 (Hackett et al. 1960). Mean monthly flow ranged from 25 to 32.2 cfs with a mean flow of 31.4 cfs for the 1952 and 1953 water years. Channel width ranges from 15 to 30 feet with a mean depth of 8 inches. This is one of the largest spring creeks in the East Gallatin and is considered the least degraded of all the creeks in the spring creek complex (MDFG 1979). Numerous wet areas were ditched to drain into Ben Hart. The flow is therefore greater than what naturally occurred.

Fisheries

No fisheries population data have been collected on Ben Hart Spring Creek. Department Fisherman Logs show the sport fishery to be dominated by brown and rainbow trout with an occasional brook trout. Tiger trout have also been caught in Ben Hart Spring Creek (F. Nelson, pers. comm.). Total length for trout species recorded in the logs ranged from 6 to 15 inches with a catch rate over the period of record (1969-84) averaging a little over .5 fish per hour. It is not known if trout from the East Gallatin River use Ben Hart for spawning habitat.

MADISON RIVER DRAINAGE

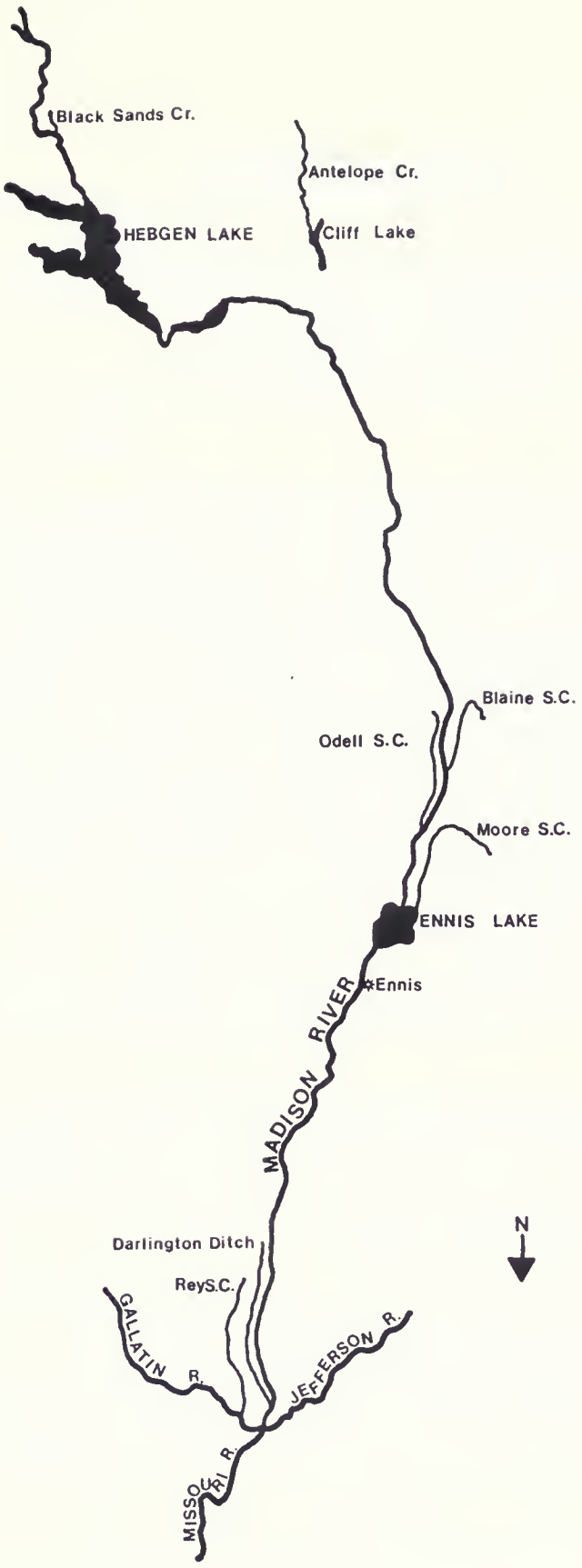

Figure 6. Madison River drainage.

BLACK SAND CREEK

Region: 3 Water Code: NA Database Code:NA
Legal Description: Origin: T13S, R05E, Section 31AC
Mouth: Same as Origin
County: Madison

General Description

Black Sand Creek flows for approximately .5 mile in a northwesterly direction before entering the South Fork of the Madison River. The South Fork is now a tributary to Hebgen Lake, a manmade reservoir in the upper reaches of the Madison River. The creek flows entirely on Beaverhead National Forest land. The major land use in the drainage is recreation. A logging sale is proposed in the drainage (J. Bagdanov,pers.comm.). Black Sand Creek is unlike most spring creeks which emerge in valleys as a fertile body of water. Black Sand Creek is volcanic in origin and sterile in water quality. It has an estimated flow of 20 cfs in an undefined channel ranging up to 50 feet wide and 6 inches deep. Its riparian zone consists of grasses, sedges, and lodgepole pine. It is open throughout much of its channel.

Habitat Trend and Limiting Factors

The habitat trend of Black Sand Creek is static. The proposed timber sale could greatly alter the habitat of the creek.

Fisheries

The resident fish population of Black Sand Creek has not been surveyed. It is considered the primary spawning stream for Hebgen Lake rainbow and brown trout (D. Vincent,pers.comm.). A survey in June, 1982 inventoried 46 rainbow trout ranging in length of 13.9 to 18.9 inches and 19 brown trout ranging from 4.7 to 17.4 inches.

Potential Value and Management Recommendations

An instream flow reservation should be filed on Black Sand Creek to protect this critical spawning area to the Hebgen Lake trout population. No timber harvest should be allowed in the drainage.

ANTELOPE SPRING CREEK

Region: 3 Water Code: 13-0120 Database Code:NA
Legal Description: Origin: T13S, R23E, Section 05AB
Mouth: T12S, R01E, Section 36AC
County: Madison

General Description

Antelope Spring Creek flows in a northerly direction for 8.5 miles before entering Cliff Lake, a popular fishing lake in the Madison River drainage. The creek is located on the Beaverhead National Forest and private land. A 1.5 mile section of creek 3 miles above the mouth is in private ownership. There are two water rights that divert the creek to irrigate hay fields. Major land uses in the drainage are grazing and recreation.

The channel width varies from 1.5 feet at the headwaters to 30 feet near the mouth. The MDFWP collected flows on the creek from May to September, 1980 (MDFWP 1981). Flows were fairly constant during the period, ranging from 14.2 to 15.3 cfs. The two water rights on the creek are for 10 cfs. The substrate composition is a gravel/volcanic origin rock mixture. Fines have accumulated in the pools. Species in the riparian zone include willow, sedges, grasses and forbs. Damage by stock use is evident but not excessive in the riparian zone.

Habitat Trend and Limiting Factors

The habitat condition remains relatively static in Antelope Creek. Dewatering may occur seasonally as a result of the two irrigation diversions.

Fisheries

Rainbow trout were the only game species surveyed in Antelope Creek (MDFWP 1981). White sucker and mottled sculpin were the two nongame species surveyed. Antelope Creek has been identified as critical spawning and rearing habitat for Cliff Lake rainbow trout. The sport fishery of the lake is maintained soley by natural reproduction from Antelope Creek and other tributaries in the drainage.

In July, 1980 a 1,000 ft section on Antelope Creek located in T12S, R01E, Sec 36A was surveyed by electrofishing (MDFWP, 1981). Rainbow trout collected ranged from 2.1 to 16.0 inches in length. A population estimate was calculated using a mark and recapture method. The estimate calculated 247 ($\pm$76) rainbow trout in a 1,000 ft section with a total biomass of 54 ($\pm$13) pounds. There was an estimated 132 trout over 6 inches.

Potential Value and Management Recommendations

An instream flow reservation should be filed on Antelope Creek to insure the protection of a critical spawning area to Cliff Lake. The MDFWP is currently working on the reservation process for the entire upper Missouri River.

BLAINE SPRING CREEK

Region: 3 Water Code: 13-0560 Database Code: ANE
Legal Description: Origin: T07S, R02W, Section 13CA
Mouth: T07S, R01W, Section 17CC
County: Madison

General Description

Blaine Spring Creek is a tributary to the Madison River, entering at river mile 55.1. Its drainage area is 3.4 mi^2 with a channel length of 5.2 miles. There are three tributaries in the drainage, Trail Creek entering at river mile 0.2, Moran Creek entering at river mile 1.4 and Wigwam Creek at river mile 4.9. Only Wigwam Creek contributes a significant flow to Blaine Spring Creek. The United States Fish and Wildlife Service owns the upper 1 mile of stream and the spring source. The sources consist of two large springs of equal size emerging from a limestone formation. The two sources converge after flowing for 100 yards. The creek flows for approximately .75 mile before it is diverted into the USFWS Ennis Fish Hatchery. The Hatchery was constructed in 1931 and currently has 18 raceways. The hatcerhy maintains 6 rainbow brood stocks and produces 20 million eggs on an annual basis (W. Orr, pers. comm.). Other land uses in the drainage include grazing, hay production and residental housing. The section below the hatchery has been subdivided into 10-20 acre tracts. The lower two miles of the creek are used primarily for agricultural production and are severely dewatered during the irrigation season. The flow of Wigwam Creek maintains the flows of Blaine Spring Creek during the summer months (F. Nelson, pers.comm.). Public access is restricted throughout most of the drainage.

Flows in Blaine Spring Creek were measured by the USGS in 1971 and 1972 above the hatchery. Flows ranged from 14.6 cfs in June to 34.4 cfs in September. Flows remained between 30.9 to 34.4 for 7 of the 12 months. Mean water temperature at the Hatchery is 54°F(12°C) (W. Orr, pers.comm). The upper 2 miles of channel is 8 to 20 feet wide with a mean depth of 8 inches. Gradient is high with a substrate composed of clean gravel and cobble. Aquatic vegetation covers approximately 40% of the channel bottom. The riparian zone is dense and is composed of willows, grasses and forbs. Water quality at the Hatchery is characterized by high productivity and low suspended solids (Appendix A).Below the subdivision, the lower channel loses much of the gradient and velocity and becomes a slow, meandering stream. Channel width ranges from 15 to 40 ft with a mean depth of 18 inches. The substrate is composed entirely of fine silts with large clumps of aquatic macrophytes. The riparian zone is

healthy and consists of willows, grasses and forbs and cottonwoods line the lower one mile of stream.

Habitat Trend and Limiting Factors

The fisheries habitat of Blaine Spring Creek is deteriorating as a result of land use practices and severe dewatering in its lower reaches. Wipperman (1967) documented 2.3 miles of Blaine Spring Creek being critically affected or dry by dewatering from irrigation. Although grazing and stock watering occur along the lower reaches of stream, habitat deterioration has not been extensive.

Fisheries

Rainbow and brown trout are the game species that have been inventoried in Blaine Spring Creek. Longnose sucker and mottled sculpin are the nongame species present. A 1,000 ft section was electrofished in 1980 at T06S, R01W, Sec 6 (F. Nelson, pers. comm.). Brown trout were the dominant species in the section. Length ranged from 3.7 to 16.2 inches. Rainbow trout ranged in total length from 3.7 to 13.4 inches.

A brown trout population estimate for the 1,000 ft section was calculated using a mark and recapture technique. Low numbers of rainbow trout (15 individuals) prevented an estimate of this species. A total estimate for the section was 438 brown trout (±123) with a total biomass of 239 pounds. There were 286 trout greater than 10 inches estimated in the 1,000 ft section.

It has not been documented if trout from the Madison River use Blaine Spring Creek as a spawning tributary.

Potential Value and Management Recommendations

The resident trout population of Blaine Spring Creek is substantial for a stream of this size. An instream flow reservation should be filed on the creek. If any water rights become available, purchase of those rights could be critical for the future of the creek. Conservation easements with existing landowners should be pursued.

ODELL SPRING CREEK

Region: 3 Water Code: 13-4400 Database Code:AN2,AN3
Legal Description: Origin: T07S, R01W, Section 09 AC
Mouth: T05S, R01W, Section 34 AB
County: Madison

General Description

Odell Spring Creek parallels the Madison River for 10.3 miles before entering the river at mile 49.0, one mile north of Ennis, Montana. The source of Odell Spring Creek is a series of spring emerging along the east side of the Madison River. There are approximately 10 landowners in the drainage. Three major landowners own 80% of the creek. The major land use activity in the valley is limited to cattle grazing. Flooding on a seasonal basis has prevented homesite and cropland development (MDFG 1979). The mouth of Odell Spring Creek is within the boundaries of a state fishing access. The next two miles, up to Highway 287 bridge, is grazed and creek water is diverted for irrigation. Public access is allowed by landowner permission. Paul Granger owns 2.5 miles above the bridge and another 2.0 miles near the headwaters. The Montana Land Reliance is currently negotiating a conservation easement on the upper 2.0 miles (J. Konigsberg, pers.comm.). Access is restricted on this property. Herb Wellington owns the majority of the 2.5 miles between the Granger properties. A conservation easement has been donated to The Nature Conservancy on this property. Catch and release only is enforced on his portion of Odell Spring Creek. Access is limited to family and friends. Several smaller landowners along the creek do allow public access.

The USGS and the MDFWP have measured the flow of Odell Spring Creek near the mouth sporadically during the late 1960's and 1970's. Flows ranged from 109 cfs in May to 143 cfs in October. The creek is seasonally subjected to overflow from the Madison River during periods of extreme high water and from flooding caused by ice jams. Summer water temperatures have been measured from 50 to 56°(10 to 13°C). Channel width ranges from 15 to 60 feet with a mean width of 25 feet in the section above Highway 287 and 35 feet below the highway. Maximum depth of pools in the lower section is 6 feet with a mean depth of 24 inches (MDFG 1979).

The channel is characterized by extensive meanders, a pool-riffle sequence and increased gradient near the mouth. The substrate composition is a gravel/cobble mixture with over 50% of the substrate covered by fine silts. There are three types of

bank cover in the drainage including heavily covered with willow and alder, open grassland and open and eroding due to heavy livestock use (MDFG 1979). Woody riparian species are limited in the upper 5 miles of creek. Cottonwood increases near the mouth. There are extensive areas of undercut banks and overhanging streambank vegetation.

Habitat Trend and Limiting Factors

The habitat trend in Odell Spring Creek is improving as a result of protection of the creek through conservation easements. Stock trampling of the banks is evident along portions of the creek but is usually not extensive. There is only one small irrigation diversion below the highway.

Fisheries

The sport fishery of Odell Spring Creek is composed of brown and rainbow trout, mountain whitefish and an occasional brook trout. Brown trout are the dominant game fish. Arctic grayling historically resided in the stream but have disappeared from the system today (D. Vincent,pers. comm.). Nongame species in the creek include mountain longnose and white sucker, longnose dace and mottled sculpin. There has been no evidence of spawning from the main river. The creek channel flows into the Madison in several channels which may restrict access(D. Vincent, pers. comm.).

Odell Spring Creek was part of a study in the late 1960's and early 1970's to determine the effects of stocked hatchery trout on wild trout populations (Vincent 1985). Catchable rainbow trout were experimentally stocked in Odell Creek for the study. Upon documentation of the negative effects of these plantings on the wild brown trout population, stocking was ceased. A population estimate in 1975 reflected the recovered population (Vincent 1985). The estimate calculated a total of 312 brown trout in a 1,000 ft section, 234 trout ranged in length from 3.5 to 9.9 inches and 78 ranged from 10.0 to 17.9 inches.

Potential Value and Management Recommendations

Protection of the highest quality spring creek in the Madison River drainage is occurring as a result of conservation easements along nearly 5 miles of creek. Every effort should be made to increase this protection through additional easements. Unfortunately, landowners generally interested in habitat protection are disinterested in public use.

MOORE SPRING CREEK

Region: 3 Water Code: 13-4000 Database Code:D73
Legal Description: Origin: T05S, R01W, Section 33 D
Mouth: T05S, R01W, Section 10
County: Madison

General Description

Moore Spring Creek flows in a southeasterly direction for approximately 3 miles before entering Ennis Lake, a reservoir located on the Madison River at river mile 45.8. Fletcher Creek is the only tributary in the drainage. Over 90% of the flow originates from the spring source in the valley. Land ownership in the drainage is divided between two landowners, both operating cattle ranches. The spring is used for grazing and stock watering. A hot springs in the drainage is currently being considered for a geothermal generation plant (D. Vincent, pers.comm.). Access is limited to family members and friends.

One flow measurement of 15 cfs was made by Department personnel in 1981 (D. Vincent,pers.comm.). Mean channel width is 21 feet with a mean depth of 12 inches. No woody species are located in the riparian zone. Grasses, sedges and forbs dominant the riparian zone and offer little cover. Substrate composition is a mixture of cobble and gravel with silt accumulating in the deeper pools. Clumps of aquatic plants are found throughout the channel.

Habitat Trend and Limiting Factors

Overuse by stock has caused bank slumping and loss of riparian zone quality in Moore Spring Creek.

Fisheries

No electrofishing surveys have been conducted on Moore Spring Creek. Based on observations from DFWP personnel, abundant populations of arctic grayling and rainbow trout reside in the lower reach. The arctic grayling is considered a species of special concern by the State of Montana. In the upper reaches, low numbers of rainbow and brown trout are present. This creek is considered an important spawning stream for the trout populations of Ennis Lake (D. Vincent, pers. comm.).

Potential Value and Management Recommendations

A fisheries inventory should be conducted on Moore Spring Creek to document existing resident populations and spawner use

from Ennis Lake. An instream flow reservation should be filed for the protection of the arctic grayling population. Opportunities for conservation easements from existing landowners should be pursued or habitat protection encouraged.

DARLINGTON DITCH

Region: 3 Water Code: 13-1520 Database Code:NA
Legal Description: Origin: T01S, R02E, Section 19A
Mouth: T02N, R02E, Section 19C
County: Madison

General Description

Darlington Ditch was originally formed in 1948 by the Army Corps of Engineers. It was created by dredging when a flood control dyke was constructed along the Madison River. The ditch parallels the river for approximately 11 miles before entering the river near the mouth at Three Forks State Park. There is no true spring source for the ditch. The base flow of the creek is provided by surfacing groundwater. There is a headgate to the Madison River at the upper and lower ends. These are used during the irrigation season to transport Madison River water. The ditch is privately owned except for a two mile portion that was included in a DFWP fishing access on the Madison River.

The ditch is characterized by a wide channel, uniform in width and depth and a low gradient and velocity. Riparian vegetation is restricted to grasses and forbs and provides no overhanging cover. In 1982, the Madison-Gallatin Chapter of Trout Unlimited reconstructed a .25 mile of ditch to form a .5 mile of stream (White 1985). Meanders, including pools and riffles, were constructed, the channel was narrowed and deepened, large rocks were installed to stabilize banks and willows were planted. Cover structures were placed along meanders during the summer of 1985 (R. White, pers.comm). The fishing regulation on the altered section has been changed to catch and release only using artificial flies and lures.

Habitat Trend and Limiting Factors

The fisheries habitat in Darlington Ditch has improved significantly in the altered section. It has remaining static throughout the remaining 10 miles. Because of channel width and depth and the openness of the banks, temperatures during the summer months can become intolerable to trout species. Flows during the summer months from irrigation diversion are excessive, increasing to 125 cfs (R. White, pers. comm.). Considerable bank scour occurs as a result of these flows. The lack of habitat diversity and erratic flow patterns have depressed the trout population.

Fisheries

Inventories of the fish populations of Darlington Ditch began in 1980 prior to the reconstruction work on the state section. Game species present included brown and rainbow trout and mountain whitefish. Nongame species were mottled sculpin and several species of suckers. The number of trout in the altered section has increased substantially as a result of the habitat improvements (Table 1). Brown trout in a 300 ft section in the altered area increased from 57 to 769 from 1980 to 1984.

Table 1. Population estimates of brown trout in the altered section of Darlington Ditch prior to and after reconstruction. Estimates are for a 300 ft section.

Year	Length Group			
	<8.0"	8-12"	>12.0"	Total
1980	39	6	11	57
1982	4	5	15	25
1983	65	11	17	92
1984	727	36	5	769

Potential Value and Management Recommendations

The potential for Darlington Ditch is severely limited without massive channel alterations throughout its length. The fact that it is not a true spring creek and will always be used as part of a larger irrigation system should be considered before further spending occurs.

REY CREEK

Region: 3 Water Code: 09-4788 Database Code: AN4
Legal Description: Origin: T01S, R02E, Section 04C
Mouth: T02N, R02E, Section 20D
County: Madison

Rey Creek parallels the Madison River for approximately 12 miles before entering the Gallatin River at river mile 2.6. The drainage is under private ownership by a number of individuals. Major land use activities include cattle grazing and irrigated hay fields. The creek is diverted for irrigation and used as part of a larger irrigation system. The channel ranges in width from 10 to 20 feet with a mean depth of 8 inches. A flow of 8 to 10 cfs was estimated at the time of the site visit in July. A water temperature of 62°(17°C) was measured at the same time. Stream morphology is a riffle/run sequence with a few pools. The substrate composition is a gravel/cobble mixture covered by accumulated silt and aquatic vegetation. The riparian zone is in poor condition and is dominated by grasses, sedges and forbs. Clumps of decadent willows are also present.

The fisheries habitat of Rey Creek is in a deteriorated condition. The banks are slumping, the substrate is covered by fines, irrigation return causes turbid conditions and the drainage is overused by stock.

Brown and rainbow trout have been inventoried in Rey Creek. Mottled sculpin, longnose sucker and longnose dace are the nongame species present. An abundance estimate has not been conducted on Rey Creek.

Fencing of the creek would greatly improve the riparian habitat of Rey Creek. A fisheries survey should be conducted to document the current population in the creek.

UPPER
MISSOURI RIVER DRAINAGE

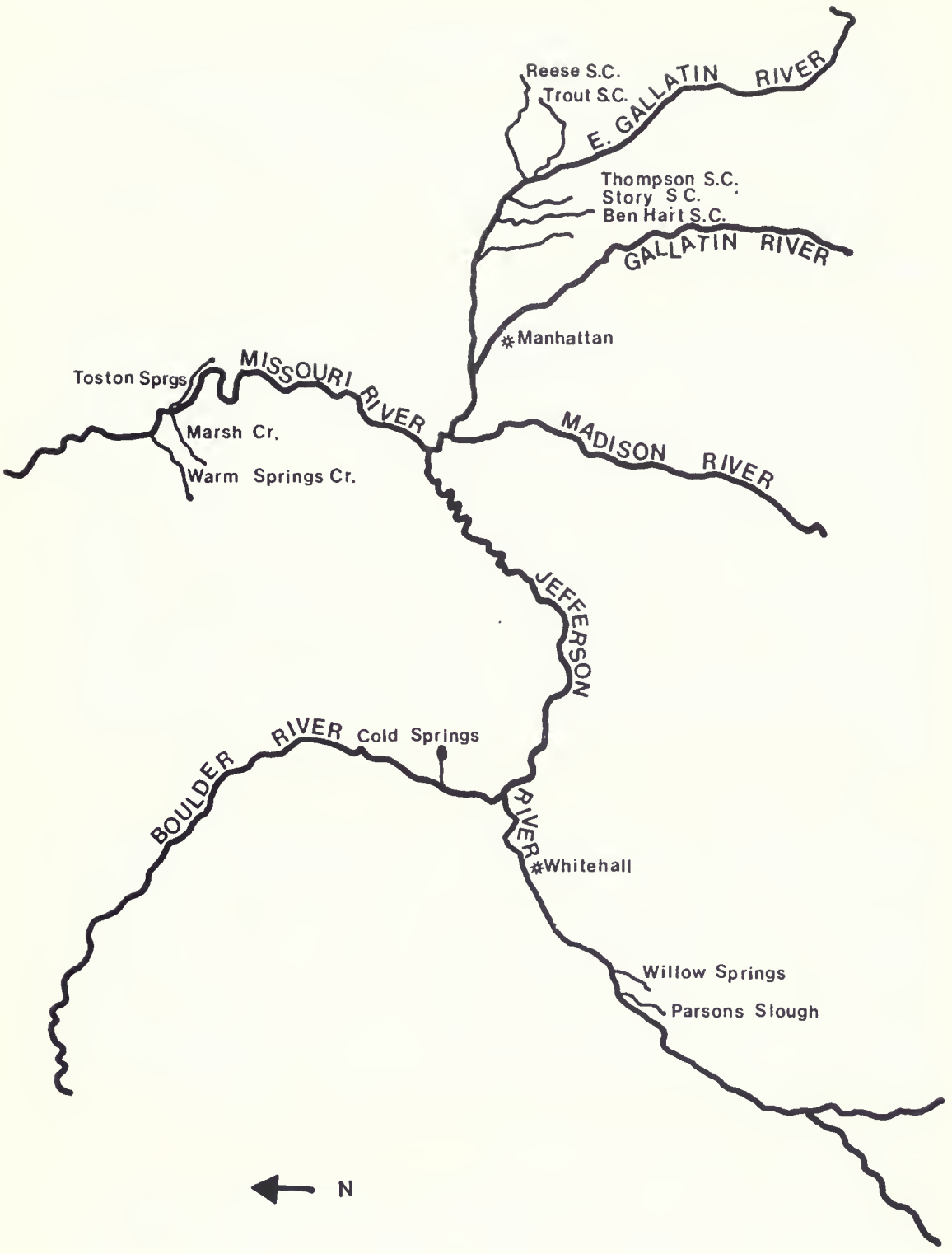

Figure 7. Upper Missouri River drainage.

TOSTON SPRINGS

Region: 3 Water Code: NA Database Code:NA
Legal Description: Origin: T04N, R03E, Section 6 D
Mouth: T05N, R02E, Section 27D
County: Broadwater

General Description

Toston Springs flows in a northerly direction in a man made channel located above and paralleling the Missouri River for 4.5 miles before entering the river at mile 2298.0 near Toston, Montana. There are currently 6 landowners with water rights to the spring. The flow is used almost entirely for irrigation during the growing season. The channel is bordered by the railroad on the east and the river on the west. The USGS and the DFWP have measured the spring flow on several occasions. Flow ranged from 43.6 cfs in 1985 to 64.4 cfs in 1922. Water temperatures have been measured at 53 to 59°F(11 to15°C) throughout the year. The channel, is 15 to 20 feet wide with a depth range of 2 to 4 feet. A headgate is located directly below the source. Water quality is excellent, the gravel/cobble substrate mixture is clean with considerable and diverse aquatic macrophytic growth(Appendix A). Species of vegetation established along the channel are comprised of willow, alder, grasses and forbs.

The commercial production of trout was considered on the springs in the late 1970's. The idea was abandoned because of financial problems. Toston Dam, a run-of-the-river dam located on the Missouri approximately one mile above the springs, is currently being studied for retrofitting for hydroelectric generation. No fisheries mitigation for loss of spawning and rearing habitat of Missouri River trout was considered during the original construction. An analysis of the retrofitting project was begun in 1985 and included the feasibility of an upstream fish passage structure. The potential for using Toston Springs as a spawning channel is also being considered in the analysis.

Habitat Trend and Limiting Factors

Toston Springs fishery potential is limited as a result of its artificial nature and the present use of its water for irrigation. The mouth of the channel enters the Missouri through a culvert which is elevated approximately 3 feet above the river edge's during most of the year.

Fisheries

Although no biological data have been collected on Toston Springs, it is doubtful that there is currently a resident fishery established in the channel. Migration by spawning fish is completely restricted because of the location of the culvert's mouth to the river's edge. Brown and rainbow trout have been observed spawning in the main river in the vicinity of the springs (B.Rehwinkel,pers. comm.).

Potential Value and Management Recommendations

The potential value of Toston Springs to the Missouri River trout population is limitless. The water quality is excellent, the temperature is within the optimum range for trout reproduction and the flow is considerable and constant. The use of this spring as a spawning channel for Missouri River trout could greatly enhance the river population.

WARM SPRINGS CREEK AND MARSH CREEK

Warm Springs Creek
Region: 3 Water Code: 17-8112 Database Code:NA
Legal Description: Origin: T04N, R01E, Section 27A
Mouth: T05N, R02E, Section 16D
County: Broadwater

Marsh Creek
Region: 3 Water Code: 17-4464 Database Code:NA
Legal Description: Origin: T04N, R02E, Section 01B
Mouth: T05N, R02E, Section 32D
County: Broadwater

General Description

Warm Springs and Marsh creeks flow in an northeasterly direction before entering the Missouri River southwest of the town of Toston, Montana. Warm Springs Creek is approximately 8 miles in length and originates from springs forming Plunkett's Lake. There are five landowners in the drainage. Land uses are restricted to cattle grazing and hay production. Access is usually allowed by permission from the landowner. Channel width ranges from 6 to 15 feet with a mean depth of 10 inches. Warm Springs has a natural flow near the headwaters of 8.7 and 9.7 cfs recorded by the USGS in 1922 and 1949,respectively.Throughout the irrigation season, however, it is used as part of the Crow Creek Irrigation System and receives flows well in excess of natural. This is evidenced by raw banks along much of its course. Over 30% of the substrate composition is boulder size with the remaining cobble/gravel mixture. Conditions are extremely turbid as a result of the sloughing banks (B. Rehwinkel, pers.comm.). Riparian vegetation is lacking along much of the banks and woody species are only present along the lower reaches of the stream. Beaver dams in the lower reaches partially block the channel.

Marsh Creek is a smaller stream, flowing for less than 2 miles. Width of the channel ranges from 6 to 10 feet. The channel has an average depth of 8 inches. Flow was estimated at 5 to 7 cfs on the day of the site visit. Flows exceed natural during most of the irrigation season. Water temperature was 63°F(17°C.) in July. Substrate composition is a mixture of gravel/cobble. Accumulated fines and thick algal mats have covered much of the substrate. Species composition in the riparian zone consists of willow, grasses and forbs. Much of the bank is open due to cattle use and excessive flows.

One rancher owning land on both streams is concerned with protecting spawning Missouri River trout in the streams. He has limited access and allowed only catch and release fishing.

Habitat Trend and Limiting Factors

Excessive irrigation flows and cattle use have deteriorated the fisheries habitat on Warm Springs and Marsh creeks. Natural clay soils have caused considerable turbidity as a result of the sloughing banks. Substrate is armoured in much of the channel.

Fisheries

No resident fisheries data have been collected on Warm Springs or Marsh Creek. Both streams have had documented spawning use from Missouri River system brown trout (B. Rehwinkel, pers. comm.). These fish are suspected to be from Canyon Ferry Reservoir. Both streams were electrofished in the fall of 1985. Extensive spawner use in Marsh Creek was documented. Only a few spawning brown trout were captured in Warm Springs Creek.

Potential Value and Management Recommendations

Spawning surveys in the fall should continue to be conducted on Warm Springs and Marsh creeks. Surveys should also be conducted in the spring to document rainbow trout use of the streams. Management recommendations include fencing of critical spawning areas and elimination of these streams from the irrigation system (B. Rehwinkel, pers. comm.). Because of the more extensive spawner use documented in Marsh Creek, this stream should be given priority if funding for fencing would become available.

MISSOURI RIVER DRAINAGE

GREAT FALLS TO JUDITH RIVER

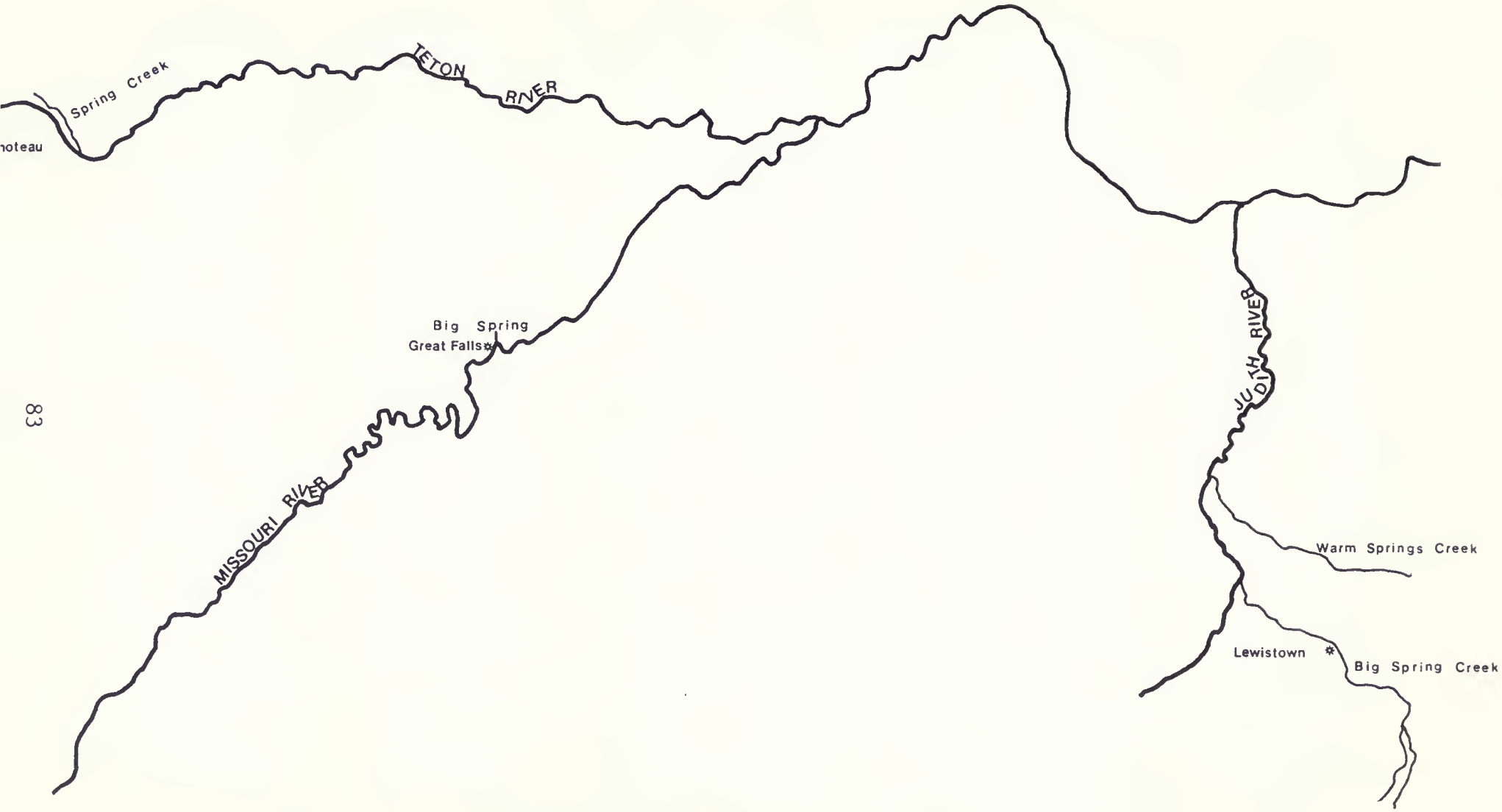

Figure 8. Missouri River drainage; Great Falls to Judith River.

GIANT SPRINGS

Region: 4 Water Code: NA Database Code: NA
Legal Description: Origin: T20N, R04E, Section 33B
Mouth: Same as Origin
County: Cascade

Giant Springs are located on the north bank of the Missouri River, two miles north of Great Falls, Montana at river mile 2,116.0. They run for approximately 100 feet before entering the river. The springs were discovered by Lewis and Clark in 1803 while portaging around the Great Falls on the Missouri River. The flow of the springs has been measured at 160 cfs. The water is a constant temperature near 54°F (12 °C) and of excellent water quality (Appendix A).

The Giant Springs State Fish Hatchery diverts approximately 15 to 18 cfs of Giant Springs for their operation. The hatchery was constructed in 1923 and considerable improvements have been made since the original development of the springs. The hatchery is a rearing facility and does not maintain a brood stock (B. Hughes, pers. comm.). Eyed rainbow eggs are received from the Jocko River State Trout Hatchery. The trout planted from the hatchery range from 1.5 inches to 9 inches in length. The fry plants make up the majority of the production from Giant Springs.

TETON SPRING CREEK

Region: 4 Water Code:14-5760 Database Code: 430
Legal Description: Origin: T24N, R05W, Section 04A
Mouth: T24N, R04W, Section 33D
County: Teton

General Description

Teton Spring Creek flows in a southeasterly direction for aprroximately 9 miles before entering the Teton River south of Choteau, Montana at river mile 180.5. The spring flows entirely through private property. A state legislative designated Bird Preserve encompasses 4.4 miles of the creek. Land uses inside and outside the preserve are cattle grazing and hay production. The creek's water is used extensively for irrigation during the summer months. The creek flows for 1 mile through the town of Choteau, its city park and the rodeo grounds. Access is granted by permission on much of the creek.

Channel width ranges from 10 to 30 feet with a mean depth of 18 inches. Stream morphology is evenly divided between riffles, runs and pools. Substrate composition is a mix of cobble and gravel free of fine sediment accumulation except in the pools. The mean water temperature for the month of July was 57°F(13°C). A flow of 9.0 cfs was recorded by the USGS in the 1970's. The riparian zone is in good condition above the town of Choteau and declines below the town. Species composition include willow, alder, grasses and forbs and an overhanging canopy is common in the upper reaches of the creek.

Habitat Trend and Limiting Factors

The fisheries habitat on Teton Spring Creek above the town of Choteau is in a static condition. Below town, however, condition deteriorates considerably. The creek has been channelized through town, trash is dumped in the creek and woody species in the riparian zone are sparse. The entire channel, upstream and downstream of Choteau is badly dewatered during the growing season as a result of irrigation withdrawl.

Fisheries

Resident game species surveyed in Teton Spring Creek are rainbow and brook trout (Hill and Phinney 1973, Hill and Poore 1974, Hill and Wipperman 1977 and 1983). Nongame species include white and longnose sucker, longnose dace, and sculpin species. Catchable rainbow trout have been planted in the city park in Choteau on an annual basis to provide for a children's fishery. Larger brown and rainbow trout surveyed in the creek on a seasonal

basis indicate spawning from the Teton River. No abundance estimate has been conducted on Teton Spring Creek.

Potential Value and Management Recommendations

Dewatering of the channel is probably the major limiting factor on Teton Spring Creek. A survey should be conducted on the creek including seasonal fisheries abundance and flow and temperature measurements to document seasonal variation as a result of irrigation withdrawl. An instream flow reservation should be filed on the creek. Other irrigation water sources should be developed.

BIG SPRING CREEK

Region: 4 Water Code: 16-0310 Database Code:292,293,294
Legal Description: Origin: T17N, R16E, Section 26DD
Mouth: T15N, R19E, Section 07DC
County: Fergus

General Description

Big Spring Creek flows in a northwesterly direction for 30 miles before entering the Judith River at mile 72.3. There are 23 tributaries in the drainage that provide substantial amounts of nonspring water only during spring runoff. The creek flows through the town of Lewistown, Montana approximately 9 miles below its origin. The entire drainage is in private ownership. Major land uses in the drainage include cattle and hay production, a timber milling operation and a state trout hatchery. The Big Spring State Hatchery is located at the head of the creek. The state owns the source. Access is limited throughout the channel, particularly on the lower 11 miles. A 25 year lease on 1.5 miles of stream was obtained in 1972 and fenced from cattle grazing.

The channel above Lewistown has a mean width and depth of 38 feet and 18 inches, respectively. Discharge was measured by the USGS at a gauging station above Lewistown from 1969 to 1972. Mean base flow discharge during the period of record was 134 cfs. Several water quality parameters were measured in 1968 and 1969 (Marcoux 1969). The water above Lewistown was of high fertility and quality with seasonal increases in turbidity. Substrate composition ranges from sand to rubble with extensive mats of aquatic vegetation. Bank cover is in good condition and present along much of the bank. Species composition include water birch, hawthorne, willow, wild rose, grasses and forbs. Banks are relatively stable with the habitat in a relative static condition.

The mean width of the channel below Lewistown to the mouth is 45 feet wide with a mean depth of 24 inches. Water temperature data were collected during the summer 1968(Marcoux 1969). Temperatures ranged from 49 to 68^{o}F(9 to 20^{o}C). A USGS gauging station below Lewistown measured flows from 1969 to 1975. Flows ranged from 138 to 1000 cfs with a base flow of 124-142 cfs. A 100 year flood event occurred in 1975 with flows measured at 2200 cfs. Total alkalinity and hardness, pH and conductivity increased at the lower stations below Lewistown (Marcoux 1969). The riparian zone is in good condition above Cottonwood Creek, 10 miles above the mouth. The channel is the most unstable in this reach with considerable channel migration, sloughing banks and greater sediment deposition. Because of this instability, the floodplain is undeveloped agriculturally.

Habitat Trend and Limiting Factors

Although Big Spring Creek is the best trout stream in central Montana, it has been plagued with continual problems throughout the last few decades. In 1961, 4200 feet of channel was bulldozed and straightened into a 2200 foot section to increase a landowner's hay land(Poore 1980). Extensive damage occurred downstream, costing nearly $1 million in public works project to correct. Considerable channel alterations have occurred through the town of Lewistown. The town's primary sewage treatment plant and a sawmill discharge their effluents into the creek. A $2 million dollar federal funded reconstruction project was started in 1970 on five upper tributaries of Big Spring Creek for flood control. Permanent homes in the upper reaches above Lewistown have caused bank instability as a result of removal of woody riparian species. Although the creek's water is used for irrigation, dewatering is not a concern. The Department owns the property where the source is located and the water rights to the source. The flow from the springs is 76 cfs with lowest flow in early winter and August.

Fisheries

Game species surveyed in the upper 10 miles of Big Spring Creek above the town of Lewistown are rainbow, brown and brook trout and mountain whitefish. Nongame species include longnose and white sucker, carp, northern redhorse and mottled sculpin. Catchable rainbow trout were stocked annually in the creek prior to 1973 (Poore 1981).

A study was initiated in 1968 to document the changes in Big Spring Creek's wild trout population prior to catchable rainbow trout stocking ceased and a change in management to year round fishing occurred(Marcoux 1969 and Peterson 1970). Population monitoring occurred from 1968 to 1982 on several sections of creek (Poore 1983). Comparison of the 1968 and 1982 population estimates above Lewistown are presented in Table 1. An increase in all age classes of rainbow trout occurred in the 15 year period. This increase probably resulted from the ceasing of stocking catchable rainbow trout in 1973. Vincent (1985) has documented the depressing effects stocking of catchable trout can have on wild trout populations. The brown trout population, however, decreased from 96 to 53 trout per 4000 feet. They declined from 49% of the trout population in 1968 to 7% in 1982. No explanation for this decline was speculated.

Table 1. Rainbow and brown trout population estimates calculated for a 3704 foot section located above Lewistown, Montana for 1968 and 1982 (Marcoux 1969 and Poore 1983). Numbers and size range for each age class are included.

Year	Age	Rainbow Trout No.	Rainbow Trout Size Range	Brown Trout No.	Brown Trout Size Range
1968	I	157	--	--	--
	II	245	--	16	--
	III	45	--	40	--
	IV+	12	--	40	--
	Total	**459**		**96**	
1982	I	498	5.6- 9.2	--	--
	II	186	9.0-11.9	5	13.8-14.2
	III	106	11.2-13.9	14	15.0-16.7
	IV+	21	13.3-14.5	34	15.6-19.0
	Total	**811**		53	

Comparison of the population estimates below Lewistown calculated in 1968 and 1981 are presented in Table 2. The rainbow trout population in this lower section experienced a doubling of their numbers in the 15 year period. Most of this increase was in young-of-the-year trout, increasing from 333 to 1343. Rainbow trout constituted 70% of the trout population in 1968 and 85% of the population in 1981. Brown trout numbers remained the same over the 15 year period. Because of the increase in the rainbow numbers, however, their percentage of the trout population decreased from 30 to 15%.

Table 2. Population estimates for rainbow and brown trout for a 4394 foot section of Big Spring Creek below Lewistown for 1968 and 1981 including numbers and size range by age class (Marcoux 1969 and Poore 1983).

Year	Age	Rainbow Trout No.	Rainbow Trout Size Range	Brown Trout No.	Brown Trout Size Range
1968	I	333	--	100	--
	II	503	--	208	--
	III	184	--	83	--
	IV+	39	--	35	--
	Total	**959**		**426**	
1981	I	1343	5.0-10.0	14	5.5- 9.4
	II	449	9.6-12.8	173	9.5-12.8
	III	259	12.6-14.9	112	12.2-14.9
	IV+	259	14.3-18.1	111	14.1-24.0
	Total	**2310**		**410**	

Potential Value and Management Recommendations

Conservation easements or land acquisitions should be obtained wherever possible on Big Spring Creek to insure preservation of the riparian habitat. Public access is severely restricted on the creek. Land acquisitions or leasing access rights would help remedy this problem. Although the rainbow trout population has increased dramatically over the last 15 years, the brown trout population has remained the same or declined. An investigation to determine the limiting factors for the brown trout population should be initiated including management recommendations.

WARM SPRINGS CREEK

Region: 4 Water Code: 16-3920 Database Code: 329
Legal Description: Origin: T16N, R20E, Section 05BD
Mouth: T18N, R16E, Section 08DB
County: Fergus

General Description

Warm Springs Creek, or Brooks Spring Creek, flows in a northwesterly direction for 45 miles before entering the Judith River. Warm Springs Creek originates on the northern slopes of the Judith Mountains. The flow in the creek above the springs is less than 4 cfs. The headwaters of the stream for this discussion will be considered at the springs located 8 miles above the mouth. The spring has a flow of 125 cfs, entering the creek from the north. Although there are 18 tributaries in the drainage, 95% of the flow originates from the springs on an annual basis (Phinney and Hill 1973). The drainage is privately owned by numerous landowners. Major land uses in the drainage are cattle grazing and hay production. In 1981, a proposal to construct a hydroelectric facility diverting 100 cfs from the creek for approximately 3 miles was proposed by a private company (Poore 1982).

The channel below the springs ranges in width from 35 to 50 feet. Flows were measured by the USGS from 1966 to 1968. Flows ranged from 123 to 270 cfs on an annual basis with a mean flow 136 cfs for 1968. Water temperatures were measured during 1968 (Baldes 1971). Temperatures ranged from 40 to 78°F(4 to 25 °C) from May to December. Temperature of the spring itself was near 68°F(20°C) during the period of record. The gradient is relatively steep for the upper 5 miles below the springs. The stream morphology is a run/riffle/pool sequence. The riparian zone is in good condition in this section. Species composition in the riparian zone include chockcherry, hawthorne, willow, water birch and grasses and forbs. Gravels are clean in this upper section and fines have accumulated in the slower runs and pools. Fish habitat deteriorates substantially in the lower 5 miles of the creek. Banks are eroding and much of the stream bank is open. Gradient decreases and fines have accumulated over much of the substrate. Aquatic vegetation is dense in the channel during the summer months.

Habitat Trend and Limiting Factors

The fisheries habitat of the lower 5 miles of Warm Springs Creek has deteriorated as a result of agricultural abuse. Excessive siltation, bank sloughing and loss of riparian habitat have contributed to this deterioration.

Fisheries

The fisheries of Warm Springs Creek has developed in the 5 mile section below the springs. Game species surveyed include rainbow trout, sauger, channel catfish, brook trout, smallmouth bass and goldeye. Nongame species include carp, longnose, white and mountain sucker, longnose dace, shorthead redhorse, mottled sculpin and fathead minnow (M.Poore, pers.comm).

The temperature of Warms Springs Creek is near 68°F(20°C) on an annual basis. Because this temperature is near the tolerance level for salmonid species, natural reproduction has been limited.The creek has been planted with rainbow trout on an annual basis since the 1950's. Currently, 7500 catchable rainbow trout are stocked on an annual basis below the springs. Brown trout were planted in 1953 and 1954. In 1973, experimental smallmouth bass fry plants were initiated and continued to 1977. Although smallmouth bass have been reported in the angler's creel, few have been captured using electrofishing (Poore 1984). All age classes of smallmouth bass have been captured, indicating natural reproduction.

Potential Value and Management Recommendations

Warm Springs Creek is a unique ecosystem found in the arid portion of central Montana. A well developed fishery fails to develop in the creek, probably as a result of the warm water temperatures. Investigations should continue to determine a species complex that would thrive in the creek's habitat below the springs.

The creek has been abused by agricultural practises and its fishery habitat continues to deteriorate. An instream flow reservation should be filed on the creek to prevent any major new diversions such as the hydroelectric facility proposed in 1981. Conservation easements should be acquired and land acquisitions for access should be investigated.

UPPER

YELLOWSTONE RIVER DRAINAGE

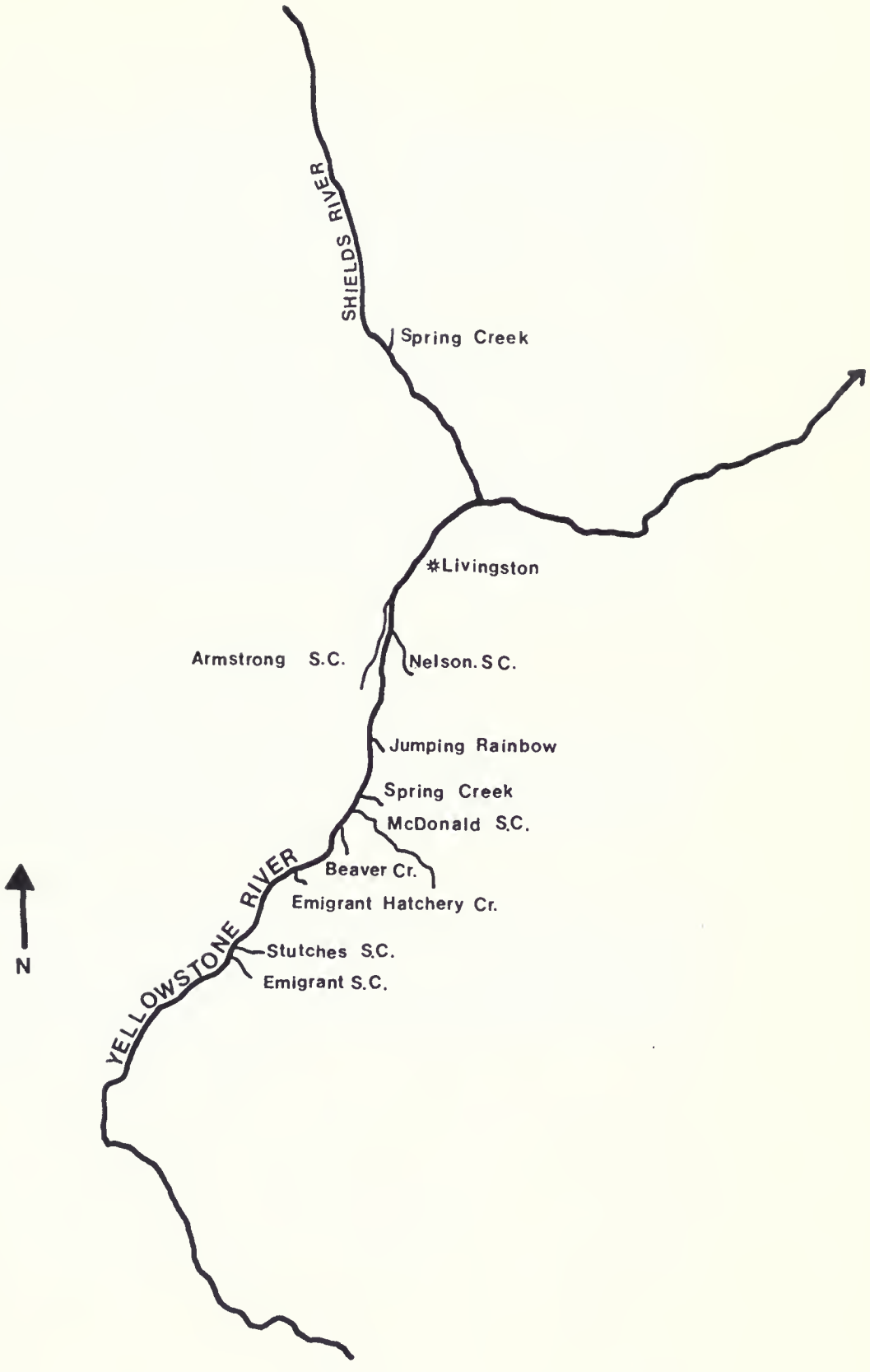

Figure 9. Upper Yellowstone River drainage map.

EMIGRANT SPRING CREEK

Region: 3 Water Code: 22-2368 Database Code: 495
Legal Description: Origin: T06S, R08E, Section 09DD
Mouth: T06S, R08E, Section 09BB

General Description

Emigrant Spring Creek flows in a northwesterly direction for less than one mile before entering the Yellowstone River at mile 528.4. Two landowners currently own Emigrant Spring Creek. Permission to fish the creek is granted from the landowner. Seventy-five percent of the creek was diverted from its original channel to allow for a larger hay meadow. Today, alteration is not apparent and the reconstructed channel contains meanders and a diversity of habitat. Current use of the creek consists of grazing and stock water. Adjacent land is used for the production of hay. Plans for fencing the creek have been made by the Joe Brooks Chapter of the Trout Unlimited in 1986 (C. Clancy, pers. comm).

There are three distinct sections in Emigrant Spring Creek. The lower section is 4 to 8 feet in width with a mean depth of 6 inches. Much of the habitat in this section is riffle with a clean substrate of cobble and gravel. Less then 5% of the riparian zone consists of woody species. Grazing in the lower section has accounted for the open banks. The gradient slows in the middle portion of the creek. Shallow pools in this area have an accumulation of fines covering the gravel/cobble substrate. Woody species have increased and account for over 20% of the bank cover. The upper section has been affected by a number of beaver dams. Much of the habitat in this section is in pools up to 3 feet deep. Over 75% of the banks are covered by woody species.

Water quality data were collected by Berg (1975) and exhibit water of high fertility and quality. The range of values were similar to that found in Armstrong and Nelson Spring Creeks. Water temperatures were collected in 1984 from February to November (Clancy 1985). Temperatures ranged from 37 to 52°F(3 to 11°C) in February and March and 44 to 56°F(7 to 13°C) during the summer months.

Habitat Trend and Limiting Factors

Riparian zone health will improve and additional bank cover will be provided when fencing occurs in 1986. Channel width in the lower sections will decrease with a subsequent increase in channel depth.

Fisheries

Resident game species in Emigrant Spring Creek include brown, brook, rainbow and Yellowstone cutthroat trout and mountain whitefish. Mottled sculpin are the only nongame species surveyed. Based on a electrofishing survey of a 500 ft section near the mouth in September, 1974,brown trout appeared to be the dominant resident species (Berg 1975). Fifty-eight brown trout with a mean length of 8.7", 3 brook trout ranging in length from 6.8 to 12.5" and 8 mountain whitefish with a mean length of 4.5" were captured. Brown, rainbow and Yellowstone cutthroat trout from the Yellowstone River have also been documented spawning in the creek (Berg 1975 and Clancy 1985). Brown trout are the dominant species using the creek.

Potential Value and Management Recommendations

With the fencing of the riparian zone to occur in 1986, no further management recommendations would be made at this time. Although Berg (1975) reported Yellowstone cutthroat trout spawning in Emigrant Spring Creek in 1974, Clancy (1984 and 1985) found no occurrence of this species in his traps during the summer. He has recommended Yellowstone cutthroat trout be imprinted in Emigrant Spring Creek to establish a spawning run. An instream flow reservation was filed on Emigrant Spring Creek with a priority date of December, 1978. The USGS is currently quantifying the reservation.

STUTCHES SPRING CREEK

Region: 3 Water Code: Database Code:
Legal Description: Origin: T06S, R08E, Section 9BAC
Mouth: T06S, R08E, Section 4CD

General Description

Stutches Spring Creek flows in a northwesterly direction for less than one mile before entering the Yellowstone River at river mile 528.9. The creek is owned by one landowner. Adjacent lands to the creek are currently being managed to optimize fish habitat. Access is restricted by the present landowner to family and friends.

A flow of 5.0 cfs was measured in March, 1982 (C. Clancy, pers. comm.). Channel width ranges from 6 to 10 feet with a mean depth of 6 inches. Depth up to 18 inches are found in the pools. The channel is characterized by 20% pools, 60% runs and 20% riffles. Substrate in the upper channel is a cobble/gravel mixture with small quantities of fines. The gradient decreases in the lower section, and fines contribute over 50% to the substrate composition. The riparian zone consists of forbs, grasses, rose and willow. Water temperatures were collected in the fall of 1984 and the summer of 1985 (C. Clancy, pers. comm.). Temperatures in October and November ranged from 38 to 48°F(3 to 9°C) and 42 to 64 ° (6 to 18°C) in June and July.

Habitat Trend and Limiting Factors

In 1982, a stream rehabilitation consulting firm built habitat improvement structures, brought in gravel and built pools in Stutches Spring Creek. As a result, the overall habitat trend of the creek is improving. The creek is affected by high water during spring runoff from the main river.

Fisheries

Game species in Stutches Spring Creek in order of abundance are brook trout, brown trout, mountain whitefish, rainbow trout and Yellowstone cutthroat trout. Yellowstone River brown trout and Yellowstone cutthroat trout have been documented spawning in the creek (Clancy 1985).

Potential Value and Management Recommendations

Because of the recent habitat improvement and the current land use, no management recommendations would be made at this time.

EMIGRANT HATCHERY SPRING CREEK

Waters from a small spring located at T05S, R08E Section 08, have historically been used for hatchery trout production. In 1924, the State of Montana operated the fish hatchery at Emigrant. In 1950's, the State closed the hatchery because the waters were too cold for efficient egg production. The water rights to the spring and the land was bought by a subsidiary of the Jumping Rainbow Ranch and converted into a commercial hatchery production. The only channel that exists connects the hatchery ponds to the Yellowstone River and is approximately .5 mile in length. Gradient is slow, substrate is 100% fines, 25% of the channel is covered by aquatic macrophytes and the banks are slumped and eroded as a result of livestock grazing.

The hatchery has recently filed for bankruptcy and the land has been acquired by a absentee landowner from Texas. Plans for the spring creek include considerable rehabilitation.

TANA RANCH
SPRING CREEK COMPLEX

Spring Creek
Region: 3 Water Code: NA Database Code: NA
Origin: T04S, R09E, Section 09AA
Mouth: T04S, R09E, Section 09BC

McDonald Spring Creek
Region: 3 Water Code: 22-3930 Database Code: 525
Legal Description: Origin: T04S, R10E, Section 16AA
Mouth: T04S, R09E, Section 09CC
County: Park

Beaver Creek
Region: 3 Water Code: NA Database Code: NA
Legal Description: Origin: T04S, R09E, Section 23DC
Mouth: T04S, R09E, Section 15AC
County: Park

General Description

There are three spring creeks that flow through the Tana Ranch located on the east bank of the Yellowstone River. The 900 acre ranch includes three miles of the river. The ranch was bought in 1979 for investment purposes by Rembrant Enterprises of Minnesota. The property is currently for sale and includes 450 acres of subirrigated lands and 450 acres of upland pasture. The spring creeks are used for stock water and irrigation. McDonald Creek flows in a northwesterly direction for 4.4 miles before entering the Yellowstone River at river mile 509.4. McDonald Creek originates on Forest Service property and receives surface flow seasonally. Spring Creek is less than .5 mile in length and originates from springs on the property. Beaver Creek, south of McDonald Creek, flows in a westerly direction for less than 1 mile before entering the Yellowstone River. It also originates from springs located on the Tana Property. Ponds were built on McDonald Creek, causing considerable habitat destruction. Only remnants of the diversion devices remain in the channel today. Access to fish these waters is currently on a permission basis from the property managers.

Flows in the three spring creeks were measured during the summer of 1985 by the USGS. Flows in McDonald, Spring and Beaver creeks were 14.4 cfs, 5.7 and 17.9 cfs,respectively. Channel morphology is limited to runs with small percentages of pools and riffles. Substrate composition in McDonald Creek is 100% fines except in the riffles where the substrate is a clean cobble/gravel mixture. There was considerable aquatic macrophytic growth and exposed gravels were armoured. Substrate in Spring

Creek is a clean gravel/cobble bottom with heavy macrophytic growth in the summer. Beaver Creek's substrate is gravel/cobble with over half of the bottom covered by a fine layer of silt. Water quality data collected by Berg (1975) showed less fertile water in McDonald Creek than the other spring creeks in the Yellowstone valley. No water quality data were collected on Spring or Beaver creeks.

The riparian zone of the three creeks consists of willows, grasses and forbs. Bank cover measurements on McDonald Creek including brush, undercut banks and debris, were made in 1974 (Berg 1975). He calculated 217 ft^2 of bank cover per 1,000 ft^2 of bank on McDonald Creek. This was the lowest bank cover of 10 streams surveyed in the Yellowstone Valley. Brush had the lowest quantity of the three parameters measured. Riparian cover on Beaver and Spring creeks were not measured during the study but subjectively, appeared of higher quality.

Habitat Trend and Limiting Factors

The Tana Ranch Spring Creek complex is in a deteriorating state. Cattle overuse has artificially widened reaches of the creeks and reduced depth. Bank trampling has caused a loss of bank cover, the substrate has been compacted and the pools have been filled by fine silts.

Fisheries

Rainbow, brown and Yellowstone cutthroat trout and mountain whitefish are the game species that have been surveyed in McDonald Creek. Nongame species include mottled sculpin. Brown trout are the dominant game species. The Yellowstone cutthroat trout is considered a species of special concern in Montana. Brown, rainbow and Yellowstone cutthroat trout from the Yellowstone mainstem have been documented using McDonald Creek for spawning (Berg 1975 and Clancy 1985).

Population estimates were calculated for brown trout in McDonald Creek using a mark and recapture method in 1974, 1975 and 1984 (Table 1)(Berg 1975 and Clancy 1985). The brown trout population has declined in the 10 year period. The reduction observed between 1974 and 1975 can be attributed to the timing of the estimates. The 1974 estimate was made in November when mature brown trout from the Yellowstone River were spawning in the stream. Total numbers from July, 1975 to September, 1984, however, have declined from 288 per 1,000 ft to 113 per 1,000 ft. Habitat deterioration is considered the major reason for this decline.

No fisheries data have been collected on Spring or Beaver creeks. The streams have been walked during various spawning periods and no fish have been observed (C.Clancy, pers. comm.).

Table 1. Population estimates of brown trout in 1974,1975 and 1984 in McDonald Creek. Estimates were made for a 1,000 ft section. Totals include trout <6.0" (Berg 1975 and Clancy 1985).

Year	6-11.9"	≥12.0"	Total
Nov.,1974	173	103	413
July,1975	171	21	288
Sept,1984	103	10	113

Potential Value and Management Recommendations

Fencing of the three spring creeks should occur to prevent further damage from livestock grazing. A fisheries and habitat survey should be conducted on Spring and Beaver creeks to document current conditions. An instream flow reservation was filed on the three creeks with a priority date of December, 1978. The USGS is currently quantifying the reservation (F.Nelson, pers. comm.).

JUMPING RAINBOW RANCH SPRING CREEK

Region: 3 Water Code: NA Database Code:NA
Legal Description: Origin: T03S, R09E, Section 35 DD
Mouth: T03S, R09E, Section 35 DD
County: Park

General Description

Jumping Rainbow Ranch Spring Creek flows in a northwesterly direction for approximately 1 mile before entering the Yellowstone River at river mile 506.7. Considerable channel alteration has occurred to this creek. In the 1970's, a series of 15 ponds were constructed on the creek for the production of commercial rainbow trout. The lower ponds were old side channels of the Yellowstone River that were filled in by groundwater. In 1984, John Sullivan bought the ranch, water rights to the springs and changed the land use of the ranch from agricultural and commercial trout production to a planned residential community. A stream rehabilitation consulting firm was contracted to reconstruct the creek to flow through the subdivision. The newly constructed channel connects with several of the ponds before flowing into the Yellowstone River.

The reconstructed channel is approximately 4 to 10 feet wide, a mean depth of 6 inches and a flow of approximately 5 cfs. A riparian zone of alfalfa, grasses and willows has been planted. Permission to fish Jumping Rainbow will be restricted to landowners in the subdivision.

Habitat Trend and Limiting Factors

The habitat trend of Jumping Rainbow Ranch Spring Creek has improved considerably since the reconstruction occurred in 1985. Prior to the construction, flows from the springs were used entirely for the production of commercial trout. Spawning trout from the Yellowstone had limited access to the springs.

Fisheries

Brook trout are the only game species that have been surveyed in Jumping Rainbow Ranch Spring Creek (Urbani and Miller 1984). Plans are to stock brown trout in the channel and rainbow trout in the ponds. Longnose and white sucker are the nongame species that have been inventoried. Since the opening of the channel to the Yellowstone River, brown trout were observed spawning in the fall of 1985 (J. Urbani, pers. comm.). Plans also include stocking Yellowstone cutthroat trout in the channel if the

last pond is removed to encourage further spawning (C. Clancy, pers. comm.).

Potential Value and Management Recommendations

As a result of the newly constructed channel and plans for the fishery in that channel, no further recommendations would be made at this time. Resident and spawning habitat for trout have been expanded as a result of this work.

ARMSTRONG SPRING CREEK

Region: 3 Water Code: 22-0140 Database Code:AGF,447
Legal Description: Origin: T03S, R09E, Section 26 BC
Mouth: T03S, R09E, Section 23 CD
County: Park

General Description

Armstrong Spring Creek parallels the Yellowstone River for nearly 3 miles before entering the river at mile 504.4 south of Livingston, Montana. Armstrong Spring Creek is nationally acclaimed for its outstanding trout fishery and its unique spring creek habitat with a history filled with controversy and public outcry.

Two landowners own Armstrong Spring Creek and its adjacent land. Warren Dupuis owns the lower one-half of the stream and has made substantial alterations in the original channel. In 1959, Dupuis diverted the creek to a longer channel with a new mouth that included a series of ponds constructed for commercial trout production. A dam was constructed across the original channel, blocking all upstream migration by Yellowstone River trout. The flow of the springs are now split into three channels with three outlets to the River. The farthest eastern channel is a high water channel used by the river during spring runoff. A fee of $30.00 per day is charged by Dupuis to the public for fishing access. Water is also diverted for irrigation purposes.

The upper landowner,Alan O'Hare, owns the upper half of the creek. The creek is in one channel and the spring source is located on his property. The creek's water and the adjacent land are used for grazing, hay production, recreational fishing and until 1981, commercial trout production. From 1969 through 1974, the Charles Brook Chapter of Trout Unlimited leased the fishing rights. Today, a trespass fee is charged to the angling public.

Channel width varies along the length of the creek, ranging from 30 to 65 feet. A flow of 102 cfs was measured by the USGS in June, 1985. Temperatures were measured during the spring and fall of 1984 and ranged from 44 to 56 ^{o}F(7 to 13^{o}C) (C. Clancy, pers.comm). Water quality is excellent and indicates water high in chemical fertility (Berg 1975). Riparian condition is of better quality on the upper section of stream and is composed of willow, alder, grasses,rose and forbs.

Habitat Trend and Limiting Factors

Habitat trend on upper Armstrong Creek remains in a static

condition. Bank trampling by cattle is evident and excessive in some areas. The lower section is in a more deteriorated condition as a result of the massive channel alterations.

Fisheries

Game species present in Armstrong Spring Creek include rainbow, brown and Yellowstone cutthroat trout and mountain whitefish. Nongame species included mottled sculpin. Armstrong Spring Creek is considered substantial habitat for the species of special concern, the Yellowstone cutthroat. Yellowstone River populations of these three species use Armstrong Spring Creek for spawning habitat in the three lower channels as well as up above.

Considerable population data have been collected on Armstrong Spring Creek. A population study was begun in 1969 when Trout Unlimited acquired the five year use lease (Berg 1975). Additional data were collected when raceways were constructed on Armstrong's property in 1974 and again in 1977 when additional raceways were proposed (Stevenson 1980).

A significant change in the population dynamics of Armstrong Spring Creek occurred when the commercial rainbow trout hatchery was constructed on the creek in 1975 (Stevenson 1980). Wild brown trout were the dominant species in the 1971 and 1972, (77 and 84, respectively)(Table 1). By the spring of 1978, 73% of the population were rainbow trout with only 27% of the population brown trout. Forty nine percent of all the rainbow trout captured showed signs of fin erosion, indicating hatchery origin. Certain sizes of brown trout appeared to be more depressed than others as a result of hatchery trout introduction.

Table 1. Spring population estimates of trout 6.0 inches and larger per 1,000 ft in Armstrong Spring Creek. (80 percent confidence limits are in parenthesis) (Stevenson 1980).

Species	Length Group (inches) 6.0-9.9	10.0-13.9	14.0-17.9	18.0+	Total
		1971			
Rainbow Trout	117	219	31	1	368(±97)
Brown Trout	680	449	76	4	1,209(±85)
Total	797	668	107	5	1,577(±182)
		1972			
Rainbow Trout	29	131	29	1	190(±28)
Brown Trout	516	448	34	4	1,002(±144)
Total	545	579	63	5	1,192(±172)
		1978			
Rainbow Trout	267	601	231	0	1,009(±346)
Brown Trout	64	228	112	0	404(±75)
Total	331	829	343	0	1,413(±421)

Angler creel from DFWP Fisherman logs reflect a similar change in species composition beginning in 1976. Rainbow remained the dominant species in the catch through the 1984 fishing season. Commercial trout are no longer being produced on O'Hare's property.

Potential Value and Management Recommendations

Armstrong Spring Creek is nationally famous for its outstanding fishery and habitat values. Because of this recognition, it deserves the highest habitat protection to allow for the maximum fisheries potential. An instream flow reservation was filed on the creek with a priority date of December, 1978. The USGS is currently quantifying the reservation (F.Nelson, pers. comm.). Management recommendations include the removal of the ponds and the diversion on the lower section. A fish abundance estimate should be conducted on the creek to document population changes following commercial hatchery trout production ceasing in 1981.

NELSON SPRING CREEK

Region: 3 Water Code: 22-4305 Database Code: 638
Legal Description: Origin: T03S, R09E, Section 26DC
Mouth: T03S, R09E, Section 23CA
County: Park

General Description

Nelson Spring Creek flows in a northwesterly direction for approximately 2 miles before entering the Yellowstone River at river mile 505.5 south of Livingston, Montana. There are two landowners on Nelson Spring Creek. Bill Dana owns the mouth and the headwater area, totalling 1.7 miles. Land use on this property includes cattle grazing and hay production. Cattle use Nelson Spring Creek for stock water and grazing. Water is withdrawn from two large irrigation diversions on the lower property. One third to one half of the water was being diverted during a site visit in July. A conservation easement was donated to Trout Unlimited in 1980 which prohibits subdivision of the ranch but does not address agricultural use. Access to the stream is restricted and generally limited to family and friends of the Dana's.

Edwin Nelson owns the middle .5 mile of Nelson Spring Creek. Creek waters are used for irrigation, stock water, commercial trout production and recreational fishing. Livestock is fenced from the creek during the summer months except for the lower 75 yards. A fee of $30.00 per day is charged to fish on the Nelson property. A limit of 6 rods per day has been placed on the creek by the landowner. Full booking occurs during the months of June through September. Rainbow trout, used for pond stocking, are raised in raceways off the spring creek. The raceways are feed by smaller springs and diverted spring creek water. The raceways drain into the creek, allowing escape of the hatchery rainbow to the spring creek.

As a result of the new stream access law passed in 1985, both landowners submitted a petition requesting Nelson Spring Creek be closed to the fishing public. Reasons for the closure included . . ."because of the potential for damage to its . . .fragile ecosystem including its irreplacable role as a spawning ground for Yellowstone River trout". The petition was denied by the Montana Fish and Game Commission. A study was initiated as a result of the petition to quantify the effects of fisherman and stock trampling on developing eggs in the gravels (C.Clancy, pers. comm.) The Commission recently changed the regulations on Nelson Spring Creek to catch and release using artificial flies and lures only. This regulation is attended to protect spawning trout.

The channel width ranges from 25 to 60 feet with a mean depth of 14 inches. The flow has been estimated at 40-50 cfs. Water temperatures were recorded during 1984 from March to November and ranged from 44 to 65°F(7 to 18°C). The instream morphology is divided between pools, runs and riffles.The substrate is clean and composed of gravel, cobble and fines. Aquatic plants cover over 50% of the bottom during the summer months. Water chemistry measured in 1974 indicated high water quality and productivity (Berg 1975). Chemistry was similar to two other spring creeks in the Yellowstone drainage, Emigrant and Armstrong. Riparian condition is very good with only a few areas of slumping, indicating cattle use. Species composition consists of forbs,sedges, grasses, willow and alder.

Habitat Trend and Limiting Factors

The habitat trend in Nelson Spring Creek is static and should remain in a similar condition unless land use or landownership changes in the future. Although the creek is used for stock water during the summer on Dana's property, bank damage has not been excessive (J.Wells, pers. comm.). Escaping rainbow trout from the raceways has the potential of changing the population dynamics of the creek.

Fisheries

Rainbow and brown trout are the resident game species found in Nelson Spring Creek. Yellowstone River populations of Yellowstone cutthroat,brown and rainbow trout use the creek as spawning habitat. The Yellowstone cutthroat trout is considered a species of special concern in the state of Montana. Nelson Spring Creek is the only tributary in the Livingston segment of the Yellowstone River that is used by the Yellowstone cutthroat and is considered critical to that population (C. Clancy, pers. comm.).

Fisheries data collection have not been extensive on Nelson Spring Creek. This has been a result of the limited public access. Inventories have been limited to documenting spawning use by the Yellowstone River trout populations. Spawner length for all three species ranged from 10.1 to 17.2 inches. Inventory data has been collected by Berg (1975) and Clancy (1984).

Potential Value and Management Recommendations

The banks of Nelson Spring Creek should be fenced from all livestock use. Cattle and horse use of the riparian zone is apparent along much of the creek. The raceways should be securely screened to prevent hatchery rainbow trout escape into the spring creek. The effect of their introduction on the wild trout resident population in the creek is unknown. Based on Vincent's (1985) work on Odell Spring Creek in the Madison, however, the accidental introduction of hatchery trout to the creek may be severely depressing the wild trout stock.

An instream flow reservation was filed on Nelson Spring Creek with a priority date of December, 1978. The USGS is currently quantifying the reservation (F. Nelson, pers. comm.).

SHIELDS RIVER SPRING CREEK

Region: 3 Water Code: NA Database Code: NA
Legal Description: Origin: T N, R E, Section
Mouth: T01N, R09E, Section 14

General Description

Shields River Spring Creek enters the Shields River at river mile 16.8 after flowing in a southeasterly direction for approximately 1 mile. The Shields River enters the Yellowstone River at mile 489.0. One landowner owns the entire stream and access is granted by permission or by use of the Highway-right-of-way. Considerable channel alteration was completed in 1985 as a result of the reconstruction of Montana Highway 89. Habitat improvement resulted from the reconstruction. An increase of stream length, additional meanders creating pools, larger culverts allowing fish passage, gravel placement and small drop structures were included in the reconstruction (R. Boland, pers. comm.). The spring creek is used for stock water and irrigation and cattle graze in the riparian zone.

A flow of 1 to 2 cfs was estimated during the site visit in July. Channel width ranges from 5 to 10 feet with a mean depth of 10 inches. Substrate composition consists of a gravel/cobble mixture with silt covering 20% of the channel. The substrate has been armoured and aquatic macrophytes are present throughout the channel. Gravel is located in areas of greatest slope and water velocity. The riparian zone is recovering from the reconstruction activities and presently consists of grasses and forbs. There are currently no woody species in the riparian zone.

Habitat Trend and Limiting Factors

The habitat trend of Shields River Spring Creek is currently improving as a result of the recent highway reconstruction. The creek is limited because of its size and the current land use in the drainage.

Fisheries

Game species surveyed in Shields River Spring Creek include brown and Yellowstone cutthroat trout and mountain whitefish. Mottled sculpin was the only nongame species inventoried. Electrofishing surveys were conducted in 1976 and 1978 near the mouth (Region 3 files). Brown trout were the most common trout collected with smaller numbers of Yellowstone cutthroat and brook trout. One large brown trout over 18inches was captured in November.This was assumed to a spawner from the Shields River.

Potential Value and Management Recommendations

Considerable habitat improvement occurred as a result of the recent highway reconstruction. Because of present land use and the small size of this spring creek, no further management recommendations would be made.

LOWER

YELLOWSTONE RIVER DRAINAGE

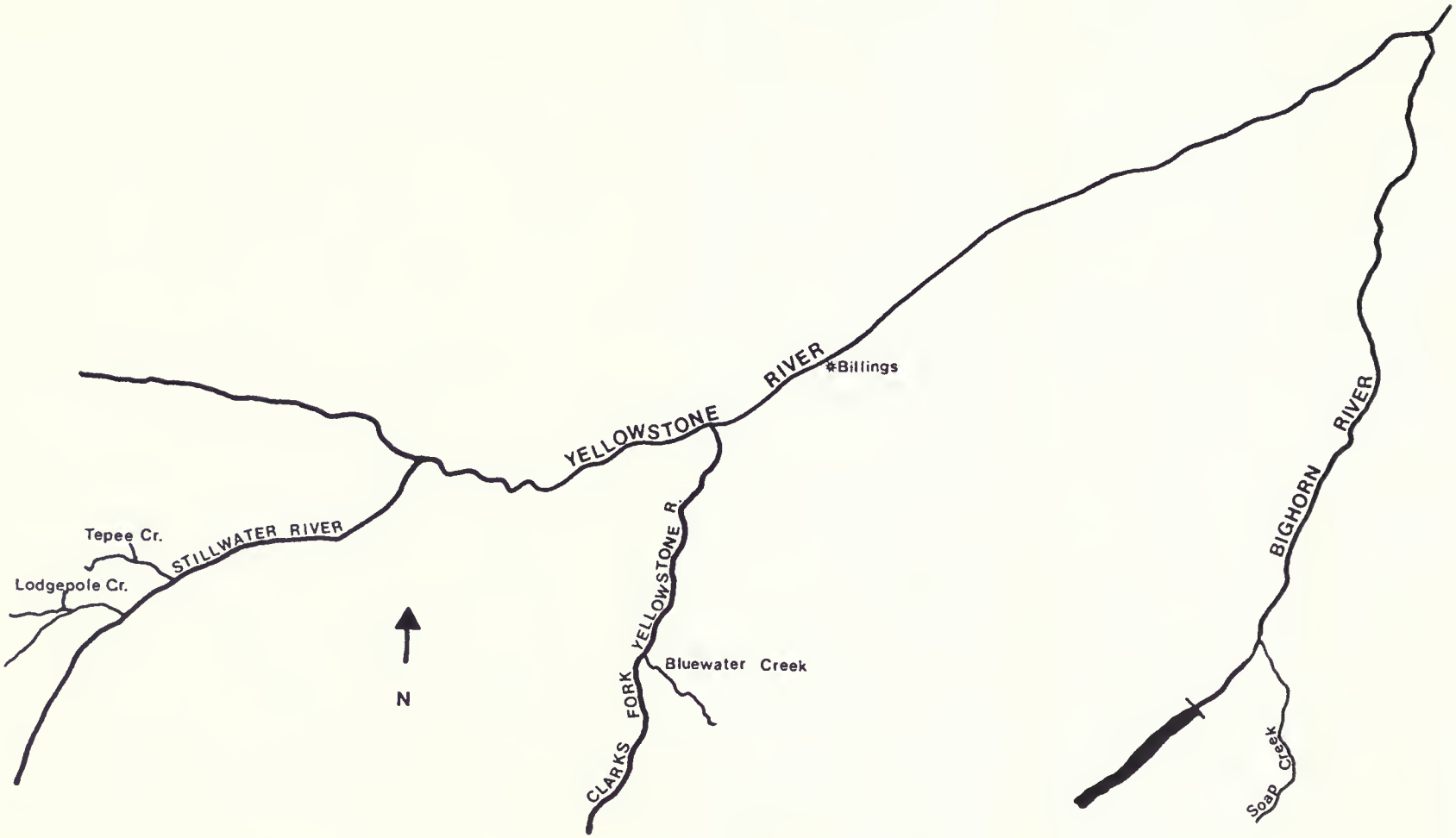

Figure 10. Lower Yellowstone River draiange.

LODGEPOLE CREEK

Region: 5 Water Code:22-3808 Database Code:AGL,175
Legal Description: Origin: T04S, R15E, Section 06C
Mouth: T04S, R15E, Section 20A
County: Stillwater

Lodgepole Creek originates in the Pryor Mountains, flowing in a southeasterly direction for 3.5 miles before entering Castle Creek, a tributary to the West Fork Stillwater River. The spring originates from limestone cliffs in the foothills of the Pryor Mountains. The creek is privately owned by three landowners. Access is granted by landowner permission. Major land uses in the drainage are cattle grazing and hay production. Water from Lodgepole Creek is used for irrigation and stock water. Irrigation return water enters the creek.

No flow data have been collected on Lodgepole Creek. Mean width of the channel is 6 feet with a mean depth of 6 inches. Water temperature was measured at 50°F(10°C) during the summer of 1975 (Marcuson 1976). Water quality is excellent and increases in fertility in a downstream direction (Marcuson 1976). The riparian zone is composed of willow, grasses and forbs. Stock trampling has damaged the riparian zone throughout the drainage.

Lodgepole Creek is considered the best fishing in the area(Marcuson 1976). Game species surveyed include brook trout in the upper reaches and brown, rainbow and brook trout in the lower reaches. No abundance estimates have been conducted on Lodgepole Creek.

TEPEE CREEK

Region: 5 Water Code: 22-6262 Database Code:163
Legal Description: Origin: T03S, R15E, Section 34D
Mouth: T04S, R15E, Section 02C
County: Stillwater

Tepee Creek originates in the Pryor Mountains of southeast Montana. It flows in a southerly direction for 1.4 miles before entering Bad Canyon Creek, a tributary to the Stillwater River. The creek is located entirely on the Custer National Forest. Cattle grazing and recreation are the major land uses in the drainage. Special values of Tepee Creek on a local basis include water volume and nutrients to downstream waters and fish food production and use as a spawning tributary.

Mean width of the channel is 4 feet with a mean depth of 5 inches. Water temperature of 55°F(13°C) was recorded in 1980(MBMG 1981). Water quality is considered excellent, containing moderate levels of dissolved nutrients (Marcuson 1976).

Yellowstone cutthroat trout were the only game fish surveyed in Tepee Creek (Marcuson 1976). No abundance surveys have been conducted.

BLUEWATER SPRING CREEK

Region: 5 Water Code:22-0714 Database Code:794,795
Legal Description: Origin: T06S, R24E, Sections 09AD & 04DD
Mouth: T05S, R23E, Section 21B
County: Carbon

General Description

Bluewater Spring Creek flows in a westerly direction for 17.5 miles before entering the Clarks Fork of the Yellowstone River at river mile 32.4, near Fromberg, Montana. There are 4 tributaries in the drainage including the North and South Fork Bluewater Creek. There are 3 landowners in the drainage including the State of Montana. Major land uses in the drainage include cattle grazing and hay production. The creek's water is used for domestic water, irrigation, stock water and trout production. The Bluewater Trout Hatchery is located at river mile 12. The hatchery was built in 1947 and currently raises 800,000 to 1,000,000 rainbow trout on an annual basis (T. Morgan, pers. comm). These trout stock lakes in southcentral Montana, from Clark Canyon Reservoir on the Beaverhead River to Glendive, Montana.

There are numerous springs in the canyon headwaters of Bluewater Spring Creek. A unique terrestrial ecosystem has developed in the drainage as a result of these springs. Within the stream's drainage, there are 1 rare terrestrial plant, 2 regional endemics and 2 southern species at their northern limits (The Nature Conservancy files). Below the hatchery, the canyon opens up and the creek meanders through a wide prairie valley.

Bluewater Spring Creek ranges in width from 11 feet in the upper section above the hatchery to 15 feet near the mouth. Flows were measured by the USGS and the MDFWP over a period of 8 years (Marcuson 1979). Flows increase from 10.5 cfs above the major springs to 41.6 cfs near the mouth. Below the hatchery, mean annual flow varied between 27-32 cfs. At the lower station, 4 miles above the mouth, flows ranged from 2.6 to 32.6 cfs. The creek is used extensively for irrigation in the lower reaches. Suspended sediment levels were measured over a 6 year period at five stations (Marcuson 1979). Mean annual suspended sediment levels increased from 25 ppm to 437 ppm from the upper to lower stations. Water temperatures below the hatchery were measured from 1967 to 1968. Temperatures ranged from 34 to 70^{o}F(1 to 21^{o}C). Temperature of the springs were more constant between 56 and 60 ^{o}F(13 and 15 ^{o}C).

The riparian zone of Bluewater Spring Creek is in good condition above the hatchery but deteriorates in the lower 9

miles. Willow and water birch are the dominant woody species in the upper reaches in addition to grasses and forbs. Clumps of willow and water birch are present on the lower reaches but much of the riparian zone has been disturbed by agricultural practices.

Habitat Trend and Limiting Factors

The lower creek travels through hay meadows, orchards and cattle pastures. Cattle grazing and intensive agricultural practices along the stream banks have caused extensive sloughing, woody riparian loss and channel widening. Irrigation water return contributes considerable levels of suspended sediment to the creek. Overgrazing by cattle has occurred in the upper drainage but has not damaged the stream channel extensively.

Fisheries

Game species in Bluewater Creek include brown trout and mountain whitefish. Historically, the stream was dominated by Yellowstone cutthroat trout. Brook trout were also common in the late 1930's but have not been surveyed in recent years (Marcuson 1979). Nongame species include longnose dace, flathead chub, mountain and white sucker, carp and shorthead redhorse.

Brown trout dominant the fishery above the hatchery. Although brown trout occasionally are picked up in the lower reaches, this section is dominated by nongame fish. Marcuson (1979) summarized 6 years of population estimates collected from 1969 to 1975. The estimate calculated 3,184 brown trout less than 6 inches and 1,336 brown trout greater than 6 inches in a 1 mile section. Mean lengths in the section of 0,I,II,III and IV+ brown trout were 3.6, 7.0, 8.5,8.5, and 9.3 inches, respectively. Maximum length recorded was 22 inches. Marcuson felt the quality and fertility of the water and habitat in this upper section should have been producing larger trout with better growth. He felt an overpopulation of gamefish was the limiting factor in the upper creek. He also found a relationship between sediment levels and numbers of trout in Bluewater Creek. As sediment levels increased above 50 ppm, a reduction in trout numbers occurred.

Potential Value and Management Recommendations

An instream flow reservation should be filed on Bluewater Spring Creek. Fencing of the stream would greatly improve the riparian zone and fish habitat along the lower reaches of the creek. Suspended sediment levels in the lower creek could be reduced by fencing as well as discontinuing the use of the creek for irrigation return.

SOAP CREEK

Region: 5 Water Code:NA Database Code:NA
Legal Description: Origin: T07S, R32E, Section 33BD
Mouth: T07S, R32E, Section 02AC

Soap Creek flows in a northwesterly direction for approximately 32 miles before entering the Bighorn River at mile 74.6. There are 3 tributaries in the drainage, West Fork and Dry Soap Creek and Goose Coulee. Numerous springs enter the creek between Limestone Canyon, mile 31.2 and Dry Soap Creek, mile 22.2. The majority of the flow above Dry Soap Creek in Soap Creek originates from these springs. The drainage is on the Crow Indian Reservation. Land use activities along the stream include cattle grazing and hay production.

Five instantaneous flows were measured by the USGS in 1965 on Soap Creek below the springs. Flows ranged from 13-21.6 cfs. Water temperatures in the spring area were measured from April to September, 1983 (B. Sanborn, pers. comm.). Temperatures ranged from 34 to 68°F(1 to 20°C). Mean July temperature was 58°F(14°C). The substrate in the spring area is composed of a clean gravel/boulder mixture with a low percentage of fines. The bottom is covered by dense beds of watercress, water buttercup and calcite deposits. The riparian zone is in good condition with species composition including willow, grasses and forbs.

Resident gamefish species in the spring area of Soap Creek are rainbow, brown and brook trout (B. Sanborn, pers. comm.). Nongame species include white and longnose sucker, longnose dace and lake chubs. The spring area is used by Bighorn River rainbow trout for spawning.

CONCLUSIONS AND RECOMMENDATIONS

In 1985, a spring creek inventory was conducted in Montana. The inventory surveyed 68 spring creeks in the state. Mean annual flows were generally above 5 cfs on the inventoried creeks unless local importance warranted the inclusion of smaller streams.

Based on data collected during the site inspections and from existing data, Montana's spring creeks have been severely abused and neglected. In general, this abuse has resulted from land use practices along the creeks. Agricultural practices including livestock and cattle production are the major land uses in the valleys where spring creeks originate and flow. Flows have been diverted or augmentd by river water for irrigation purposes, riparian habitat has been removed and livestock use has caused losses in bank and instream cover, channel widening and sediment deposition.

Management recommendations were included in each creek narrative. A major effort would be necessary to rehabilitate, restore and protect the spring creek resource of Montana. To accomplish this goal, recommendations include:

1). A fisheries and habitat survey be conducted on all spring creeks where data of this nature has not been collected in the last 5 years.

2). Following these surveys, creeks should be prioritized based on their local, regional or drainage importance. Prioritization should include resident fisheries potential, adding spawning habitat to the mainstem population and/or increasing water quality to the mainstem.

3). Potential funding sources should be located and contacted. These could include sportsman groups, state agencies, federal funding and professional societies.

4). Highest prioritized creeks should be investigated for potential acquisition, conservation easements and fencing and/or other rehabilitation needs. Appropriate funding sources should be contacted and matched with appropriate projects.

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APPENDIX A

WATER QUALITY DATA

BLAINE SPRING CREEK, 1982

ANALYSIS OF WATER SAMPLES FROM THE ENNIS NATIONAL FISH HATCHERY, 24 MAY 1982

Element	Main Hatchery Intake (E-1)	West Heat Pump Outflow (E-2)	East Heat Pump Outflow (E-3)	Main Hatchery Outflow (E-4)	Concentration[a/] Units	Detection Limits
B	<10	<10	<10	<10	ppb	10
Cd	< 0.5	< 0.5	< 0.5	< 0.5	ppm	0.5
Be	< 2	< 2	< 2	< 2	ppb	2
Mg	14.0	7.3	10.8	19.3	ppm	0.1
P	< 1	< 1	< 1	< 1	ppm	1
Si	3.6	3.4	3.6	3.3	ppm	0.05
Mo	< 0.05	< 0.05	< 0.05	< 0.05	ppm	0.05
Mn	7	9	10	25	ppb	2
Ni	< 0.05	< 0.05	< 0.05	< 0.05	ppm	0.05
Na	3.1	3.1	3.1	3.2	ppm	0.05
Cu	< 2	< 2	3	< 2	ppb	2
Al	< 0.02	< 0.02	< 0.02	< 0.02	ppm	0.02
Ca	47.9	45.4	46.0	45.0	ppm	0.01
Ba	53	51	55	55	ppb	1
K	1.51	1.42	1.46	1.49	ppm	0.05
Cr	< 0.1	< 0.1	< 0.1	< 0.1	ppm	0.1
Sr	< 0.05	< 0.05	< 0.05	< 0.05	ppm	0.05
Pb	< 0.3	< 0.3	< 0.3	< 0.3	ppm	0.3

[a/] ppm = µg/ml, ppb = µg/l

STATE HEALTH DEPT. WATER QUALITY BUREAU HELENA, MONTANA 59601

STATE	MONTANA	COUNTY	MADISON
LAT.-LONG.	+451819N 1114745W	SAMPLE LOCATION	7S 2W 13C
STATION CODE		ANALYSIS NUMBER	7ow0326
DATE SAMPLED	02-25-76	DRAINAGE BASIN	
TIME SAMPLED	1500	WATER FLOW RATE	.
METHOD SAMPLED	GRAB	FLOW MEASUREMENT METHOD	
SAMPLE SOURCE	BLAINE SPRING CREEK	ALTITUDE OF LAND SURFACE	
WATER USE		TOTAL WELL DEPTH BELOW LS	
AQUIFER(S)		SWL ABOVE(+) OR BELOW LS	
SAMPLED BY	NFH	SAMPLE DEPTH BELOW SURFACE	

SAMPLING SITE: ENNIS NATIONAL FISH HATCHERY

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)	47.9	2.392	BICARBONATE(HCO3)	182.	2.989
MAGNESIUM (MG)	23.9	1.916	CARBONATE (CO3)	0.	0.0
SODIUM (NA)	2.5	0.109	CHLORIDE (CL)	0.5	0.014
POTASSIUM (K)			SULFATE (SO4)	66.	1.374
IRON (FE)			FLUORIDE (F)	.30	0.020
MANGANESE (MN)			NITRATE (NO3 AS N)		
ALUMINUM (AL)			NO3+NO2 (TOT AS N)	.42	0.023
			PHOSPHATE(PO4 AS P)		
TOTAL CATIONS		4.417	TOTAL ANIONS		4.420

LABORATORY PH	8.12	TOTAL HARDNESS AS CACO3	216
FIELD WATER TEMPERATURE (C)		TOTAL ALKALINITY AS CACO3	150
DISSOLVED SOLIDS CALCULATED	328.3	LAB TURBIDITY (JTU)	
LAB CONDUCTIVITY-UMHOS-25C	423..	SODIUM ADSORPTION RATIO	0.1

ADDITIONAL PARAMETERS

IRON,TR (MG/L AS FE) .05

REMARKS: PRIVATE WATER SUPPLY WARM SPRINGS

EXPLANATION: MG/L=MILLIGRAMS PER LITER MEQ/L=MILLIEQUIVILENTS PER LITER
ALL CONSTITUENTS DISSOLVED (DISS) EXCEPT AS NOTED. TOT=TOTAL SUSP=SUSPENDED
(M)= MEASURED(R)=REPORTED (E)=ESTIMATED M=METERS TR=TOTAL RECOVERABLE

SAMPLE NO SAMPLER WHO HANDLING 1000 ANALYST ME LAB KQUH
COMPLETED 03-10-76 COMPUTER RUN 03/17/76 PROGRAM SYS 76 FUND 0650

STND DEV. ION BALANCE 0.02	CA	MG	NA	K	CL	SO4	HCO3	CO3	NO3
SEGMENT MODES	94.2	43.4	2.5	0.0	0.5	31.4	68.3	0.0	0.0

7ow0326

STANLEY CREEK, KOOTENAI RIVER DRAINAGE

Table II-8 TYPICAL WATER QUALITY DATA FROM SELECTED STREAMS AND LAKES IN THE LAKE CREEK DRAINAGE, LINCOLN COUNTY, MONTANA

	STATION													
	Stanley Ck								Lake Cr. near	Stanley Cr. near	Ross Cr. near		S. End	Spar Lake
PARAMETER	NAD	SC1	SC3	LC1	LC2	LC4	KR1	SA0	Troy	Troy	Troy	Bull R. No. 12	of Bull Lake	near campground
Sampling Agency	WQB	WQB	WQB	WQB	WQB	WQB	WQB	WQB	USGS	USGS	USGS	ASARCO	ASARCO	ASARCO
Date Sampled	6/26/77	6/26/77	3/21/77	6/26/77	6/25/77	6/25/77	6/25/77	9/30/76	4/28/77	4/28/77	4/28/77	10/16/75	16/16/75	10/16/75
Temperature (°C)	5.0	9.0	5.5	18.0	15.0	15.0	12.0	6.5	6.5	5.5	6.5	8.5	13.0	11.0
Flow (cfs)	.15	2.1	-	93	87	147	3450	-	660	34	300	-	-	-
Specific Conductance (umhos/cm)	116	57	51	62	67	84	261	187	55	56	45	66	43	28
Total Dissolved Solids (mg/l)	100	-	60.	-	-	-	-	147	32	36	27	94	78	36
pH (units)	8.1	8.2	7.7	8.2	8.0	8.2	8.5	7.3	8.0	7.6	7.8	7.3	7.6	7.4
Total Suspended Solids (mg/l)	10.8	11.7	-	<11.1	<9.4	<13.0	<9.5	-	-	-	-	-	-	-
Turbidity (JTU)	0.3	0.3	-	0.6	0.4	0.7	0.8	-	15.0	0	1.0	.38NTU	.34 NTU	.33 NTU
Alkalinity (mg/l as $CaCO_3$)	60	-	27	-	-	-	109	-	23	28	18	-	-	-
Hardness, Total (mg/l)	58	-	36	-	-	-	95	-	25	31	21	-	-	-
Non Carbonate Hardness (mg/l)	-	-	-	-	-	-	-	-	2	3	3	-	-	-
Calcium (mg/l as Ca)	19.6	-	10.5	-	-	-	-	27.3	7.1	8.9	6.2	12.2	7.9	4.9
Magnesium (mg/l as Mg)	2.2	-	2.5	-	-	-	-	6.5	1.7	2.2	1.4	3.45	1.89	1.08
Sodium (mg/l as Na)	0.8	-	0.4	-	-	-	-	1.1	.7	.5	.2	.95	.58	.56
Potassium (mg/l as K)	0.38	-	0.0	-	-	-	-	0.43	.4	.2	.1	1.0	.66	.54
Bicarbonate (mg/l as HCO_3)	73	-	33	-	-	-	129	91	28	34	22	22.9	14.8	9.0
Carbonate (mg/l as CO_3)	0	-	0	-	-	-	2	0	0	0	0	0	0	0
Chloride (mg/l as Cl)	0.5	-	0.1	-	-	-	-	0	.2	.1	.3	1.25	.38	.27
Sulfate (mg/l as SO_4)	3.2	-	14.0	-	-	-	-	20.0	2.9	1.8	3.7	<1.0	<1.0	<1.0
Fluoride (mg/l as F)	<0.5	-	-	-	-	-	-	.12	.0	.0	.1	.08	.03	.056
Silicate (mg/l as SiO_2)	-	-	-	-	-	-	-	-	5.2	5.8	4.3	-	-	-
Cyanide (mg/l as CN)	-	-	-	-	-	-	-	-	.00	.00	.00	.002	<.001	<.001
Total Nitrogen (mg/l as N)	<0.10	.47	-	.49	.39	.49	.37	-	.10	.09	.38	-	-	-
Total Organic Nitrogen (mg/l as N)	-	-	-	-	-	-	-	-	.00	.00	.00	-	-	-
Total NH_3 Nitrogen (mg/l as N)	<0.01	<0.01	-	<0.01	<0.01	<0.01	<0.01	-	.00	.00	.00	-	-	-
Total Kjeldahl Nitrogen (mg/l as N)	-	-	-	-	-	-	-	-	.00	.00	.00	-	-	-
Total NO_2+NO_3 (mg/l as N)	.21	.14	-	.04	.04	.03	<.01	.45	.10	.09	.38	.01	.004	.004
Total Phosphorus (mg/l as P)	.004	.009	-	.004	.004	.004	.008	-	.00	.00	.01	-	-	-
Phosphate (mg/l as P)	.002	-	-	.001	<.001	<.001	<.001	-	-	-	-	.025	.055	.02
Sodium Adsorption Ratio	0.0	-	0.0	-	-	-	-	0.0	0.1	0.0	0.0	-	-	-
Carbon Dioxide (mg/l as CO_2)	-	-	-	-	-	-	-	-	0.4	1.4	0.6	-	-	-
Dissolved Oxygen (mg/l as O_2)	-	-	-	-	-	-	-	-	11.0	11.5	11.8	12.9	11.3	10.0
Total Coliform/100 ml	-	-	-	-	-	-	-	-	-	-	-	4	12	2
Fecal Coliform/100 ml	-	-	-	-	-	-	-	-	-	-	-	0	0	0
Phenol (mg/l)	-	-	-	-	-	-	-	-	-	-	-	<.008	<.008	<.008

Table II-8 (continued)

PARAMETER	Stanley Cr. NAD	SC1	SC3	LC1	LC2	LC4	KR1	SAD	Lake Cr. near Troy	Stanley Cr. near Troy	Ross Cr. near Troy	Bull R. No. 12	S. End of Bull Lake	Spar Lake near campground
Oil and Grease (mg/l)	-	-	-	-	-	-	-	-	-	-	-	5.9	6.0	7.7
BOD (mg/l as O_2)	-	-	-	-	-	-	-	-	-	-	-	0.9	1.3	0.8
COD (mg/l as O_2)	-	-	-	-	-	-	-	-	-	-	-	2.8	6.65	7.35
ABS (mg/l as O_2)	-	-	-	-	-	-	-	-	-	-	-	0.03	0.03	0.01
Aluminum, Diss. (mg/l as Al)	<.10	-	-	-	-	-	-	-	-	-	-	.06	<.001	<.001
Aluminum, TR (mg/l as Al)	<.10	-	-	-	-	-	-	-	-	-	-	-	-	-
Antimony, Diss. (mg/l as Sb)	-	-	-	-	-	-	-	-	-	-	-	.14	.10	.082
Arsenic, Diss. (mg/l as As)	<.001	-	-	-	-	-	-	-	.000	.000	.000	.002	<.001	<.001
Arsenic, TR (mg/l as As)	.001	-	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic, Total (mg/l as As)	-	-	-	-	-	-	-	-	.000	.000	.000	-	-	-
Barium, Diss. (mg/l as Ba)	-	-	-	-	-	-	-	-	-	-	-	1.52	1.04	.79
Beryllium, Diss. (mg/l as Be)	-	-	-	-	-	-	-	-	-	-	-	<.001	<.001	<.001
Boron, Diss. (mg/l as B)	-	-	-	-	-	-	-	-	.000	.000	.000	-	-	-
Cadmium, Diss. (mg/l as Cd)	<.005	-	-	-	-	-	-	-	.000	.000	.000	.009	<.001	<.001
Cadmium, TR (mg/l as Cd)	<.005	-	-	-	-	-	-	<.005	-	-	-	-	-	-
Cadmium, Total (mg/l as Cd)	-	-	-	-	-	-	-	-	<.010	<.010	<.010	-	-	-
Chromium, Diss. (mg/l as Cr)	-	-	-	-	-	-	-	-	.000	.000	.000	<.001	<.001	<.001
Chromium, Total (mg/l as Cr)	-	-	-	-	-	-	-	-	.000	.000	.000	-	-	-
Cobalt, Diss. (mg/l as Co)	-	-	-	-	-	-	-	-	-	-	-	<.001	<.001	<.001
Copper, Diss. (mg/l as Cu)	.02	.01	<.01	<.01	<.01	<.01	<.01	-	.000	.000	.000	.003	.003	.004
Copper, TR (mg/l as Cu)	.02	-	<.01	-	-	-	-	.05	-	-	-	-	-	-
Copper, Total (mg/l as Cu)	-	-	-	-	-	-	-	-	<.010	<.010	<.010	-	-	-
Iron, Diss. (mg/l as Fe)	<.01	-	<.05	-	-	-	-	-	.020	.010	.010	.27	.091	.03
Iron, TR (mg/l as Fe)	<.01	-	<.05	-	-	-	-	<.05	-	-	-	-	-	-
Iron, Total (mg/l as Fe)	-	-	-	-	-	-	-	-	.810	.010	.060	-	-	-
Lead, Diss. (mg/l as Pb)	<.05	-	-	-	-	-	-	-	.000	.000	.000	.005	.002	.009
Lead, TR (mg/l as Pb)	<.05	-	-	-	-	-	-	<.05	-	-	-	-	-	-
Lead, Total (mg/l as Pb)	-	-	-	-	-	-	-	-	<.100	<.100	<.100	-	-	-
Manganese, Diss. (mg/l as Mn)	-	-	-	-	-	-	-	-	.000	.000	.010	.008	.015	.005
Manganese, TR (mg/l as Mn)	-	-	-	-	-	-	-	.03	-	-	-	-	-	-
Manganese, Total (mg/l as Mn)	-	-	-	-	-	-	-	-	.020	.000	.010	-	-	-
Mercury, Diss. (mg/l as Hg)	<.0002	-	-	-	-	-	-	-	.0000	.0000	.0000	<.001	<.001	.002
Mercury, TR (mg/l as Hg)	<.0002	-	-	-	-	-	-	-	-	-	-	-	-	-
Mercury, Total (mg/l as Hg)	-	-	-	-	-	-	-	-	.0000	.0000	.0002	-	-	-
Molybdenum, Diss. (mg/l as Mo)	-	-	-	-	-	-	-	-	-	-	-	<.01	<.01	<.01
Selenium, Diss. (mg/l as Se)	-	-	-	-	-	-	-	-	.000	.000	.000	<.002	<.002	<.002
Selenium, Total (mg/l as Se)	-	-	-	-	-	-	-	-	.000	.000	.001	-	-	-
Silver, Diss. (mg/l as Ag)	-	-	-	-	-	-	-	-	-	-	-	<.001	<.001	<.001
Silver, TR (mg/l as Ag)	-	-	-	-	-	-	-	<.01	-	-	-	-	-	-
Tellurium, Diss. (mg/l as Te)	-	-	-	-	-	-	-	-	-	-	-	.009	.012	.02

Table II-8 (continued)

PARAMETER	NA0	Stanley Cr. SC1	SC3	LC1	LC2	LC4	KR1	SA0	Lake Cr. near Troy	Stanley Cr. near Troy	Ross Cr. near Troy	Bull R. No. 12	S. End of Bull Lake	Spar Lake near campground
Tin, Diss. (mg/l as Sn)	-	-	-	-	-	-	-	-	-	-	-	.10	<.01	<.01
Titanium, Diss. (mg/l as Ti)	-	-	-	-	-	-	-	-	-	-	-	<.01	<.01	<.01
Zinc, Diss. (mg/l as Zn)	<.01	<.01	<.01	<.01	<.01	<.01	<.01	-	.000	.000	.000	.020	.006	.004
Zinc, TR (mg/l as Zn)	<.01	-	<.01	-	-	-	-	<.01	-	-	-	-	-	-
Zinc, Total (mg/l as Zn)	-	-	-	-	-	-	-	-	.040	.000	.000	-	-	-

TOSTON SPRINGS WATER QUALITY DATA: COLLECTED BY THE USGS IN 1922 AND 1949

Analyses of Spring Water
(Parts Per Million)

Constituent	Big Spring 1922	Big Spring 1949
Silica (SiO_2)	20	23
Calcium (Ca)	46	44
Magnesium (Mg)	17	18
Sodium and Potassium (Na + K)	17	19
Bicarbonate (HCO_3)	183	192
Sulfate (SO_4)	57	52
Chloride (Cl)	8	7
Nitrate (NO_3)	0.49	0.8
Hardness (as $CaCO_3$)	185	184
Dissolved Solids	259	266

The U. S. Geological Survey properly concluded that the properties of the spring water had undergone little change between 1922 and 1949.

BLUEWATER CREEK, YELLOWSTONE RIVER DRAINAGE

Range and mean chemical values at two stations on Bluewater Creek

	Stations 1	2
Alkalinity (ppm $CaCO_3$)		
range	94. - 220	101 - 252
mean	210	212.
Dissolved oxygen (ppm)		
range	7.8 - 10.8	8.0 - 10.4
mean	8.7	8.6
pH		
range	7.6 - 8.6	6.6 - 8.7
Total hardness (ppm $CaCO_3$)		
range	280 - 750	480 - 1,050
mean	451	850
Conductivity (Umhos)		
range	721 - 938	812 - 2,650
mean	825	1,122
Silica (ppm)		
range	8.2 - 12.4	8.0 - 12.8
mean	11.2	12.4
Phosphate (P)	.01	.02
Sodium (Na^+)	5.52	12.87
Potassium (K^+)	1.96	2.42
Sulfate ($SO_4^=$)	25.8	70.8
Nitrogen (NO_{3-N})	.312	.409
Chloride (ppm)	2.20	2.45
Fluoride (ppm)	1.12	1.19

GIANT SPRINGS

STATE	MONTANA	COUNTY	CASCADE
LATITUDE-LONGITUDE	47D32'04"N 111D13'45"W	SITE LOCATION	21N 4E 33 BDAD 1
UTM COORDINATES	Z12 N5264345 E482820	MBMG SITE	
TOPOGRAPHIC MAP	NORTHEAST GREAT FALLS 7.1	STATION ID	473204111134501
GEOLOGIC SOURCE	330MDSN* *	SAMPLE SOURCE	SPRING
DRAINAGE BASIN	BB	LAND SURFACE ALTITUDE	324.0 FT < 10
AGENCY + SAMPLER	USGS*KRW	SUSTAINED YIELD	298. CFS
BOTTLE NUMBER	1	YIELD MEAS METHOD	CURRENT METER
DATE SAMPLED	20-AUG-79	TOTAL DEPTH OF WELL	
TIME SAMPLED	12:00 HOURS	SWL ABOVE(-) OR BELOW GS	
LAB + ANALYST	MBMG*FNA	CASING DIAMETER	
DATE ANALYZED	04-APR-80	CASING TYPE	
SAMPLE HANDLING	3120	COMPLETION TYPE	*
METHOD SAMPLED	GRAB	PERFORATION INTERVAL	
WATER USE	OTHER		

SAMPLING SITE GIANT SPRINGS*1 MI W RAINBOW DAM
GEOLOGIC SOURCE MADISON GROUP OR LIMESTONE

	MG/L	MEQ/L		MG/L	MEQ/L
CALCIUM (CA)	90.7	4.53	BICARBONATE (HCO3)	221.	3.62
MAGNESIUM (MG)	30.3	2.49	CARBONATE (CO3)	0.	
SODIUM (NA)	9.2	0.40	CHLORIDE (CL)	4.9	0.14
POTASSIUM (K)	2.3	0.06	SULFATE (SO4)	180.	3.75
IRON (FE)	.10	0.01	NITRATE (AS N)	.53	0.04
MANGANESE (MN)	.01	0.00	FLUORIDE (F)	.5	0.03
SILICA (SIO2)	11.2		PHOSPHATE TOT (AS P)		
TOTAL CATIONS		7.48	TOTAL ANIONS		7.57

STANDARD DEVIATION OF ANION-CATION BALANCE (SIGMA) 0.41

LABORATORY PH	7.73	TOTAL HARDNESS AS CACO3	351.19
54°F FIELD WATER TEMPERATURE	12.5	TOTAL ALKALINITY AS CACO3	181.26
CALCULATED DISSOLVED SOLIDS	438.61	SODIUM ADSORPTION RATIO	0.21
SUM OF DISS. CONSTITUENT	350.74	RYZNAR STABILITY INDEX	6.84
LAB SPEC.COND.(MICROMHOS/CM)	627.8	LANGLIER SATURATION INDEX	0.45

PARAMETER	VALUE	PARAMETER	VALUE
PH,FIELD(SU)	7.4	CNDUCTVY,FIELD MICROMHOS	630.
LITHIUM,DISS(MG/L AS LI)	.027	ARSENIC,DISS(UG/L AS AS)	1.3
MERCURY,DISS(UG/L AS HG)	.3	CHROMIUM, DISS (MG/L-CR)	<.01
COBALT,DISS (MG/L AS CO)	.03	LITHIUM,DISS(MG/L AS LI)	.027
CADMIUM,DISS(MG/L AS CD)	<.01	COPPER,DISS (MG/L AS CU)	<.01
ZINC,DISS (MG/L AS ZN)	<.01	LEAD,DISS (MG/L AS PB)	<.05

REMARKS: CASCADE COUNTY * STATE FISH HATCHERY * SAMPLED FROM STILLING WELL IN PUMP HOUSE *

EXPLANATION: MG/L = MILLIGRAMS PER LITER, UG/L = MICROGRAMS PER LITER, MEQ/L = MILLIEQUIVELENTS PER LITER. FT = FEET, MT = METERS. (M) = MEASURED, (E) = ESTIMATED, (R) = REPORTED. TR = TOTAL RECOVERABLE. TOT = TOTAL.

	OW	WA	62	WI	OW	PW	AT	OTHER
OTHER AVAILABLE DATA	Y			Y				
OTHER FILE NUMBERS:	72M0338			79I00191				

PROJECT: COST:
LAST EDIT DATE: 27-MAY-80 BY: TP *CLB
PROCESSING PROGRAM: F1730P V1 (8/20/79) PRINTED: 27-MAY-80

PERCENT MEQ/L (FOR PIPER PLOT)

CA	MG	NA	K	CL	SO4	HCO3
60	33	5	0	1	49	47

NOTE: IN CORRESPONDENCE, PLEASE REFER TO LAB NUMBER: 79M3219

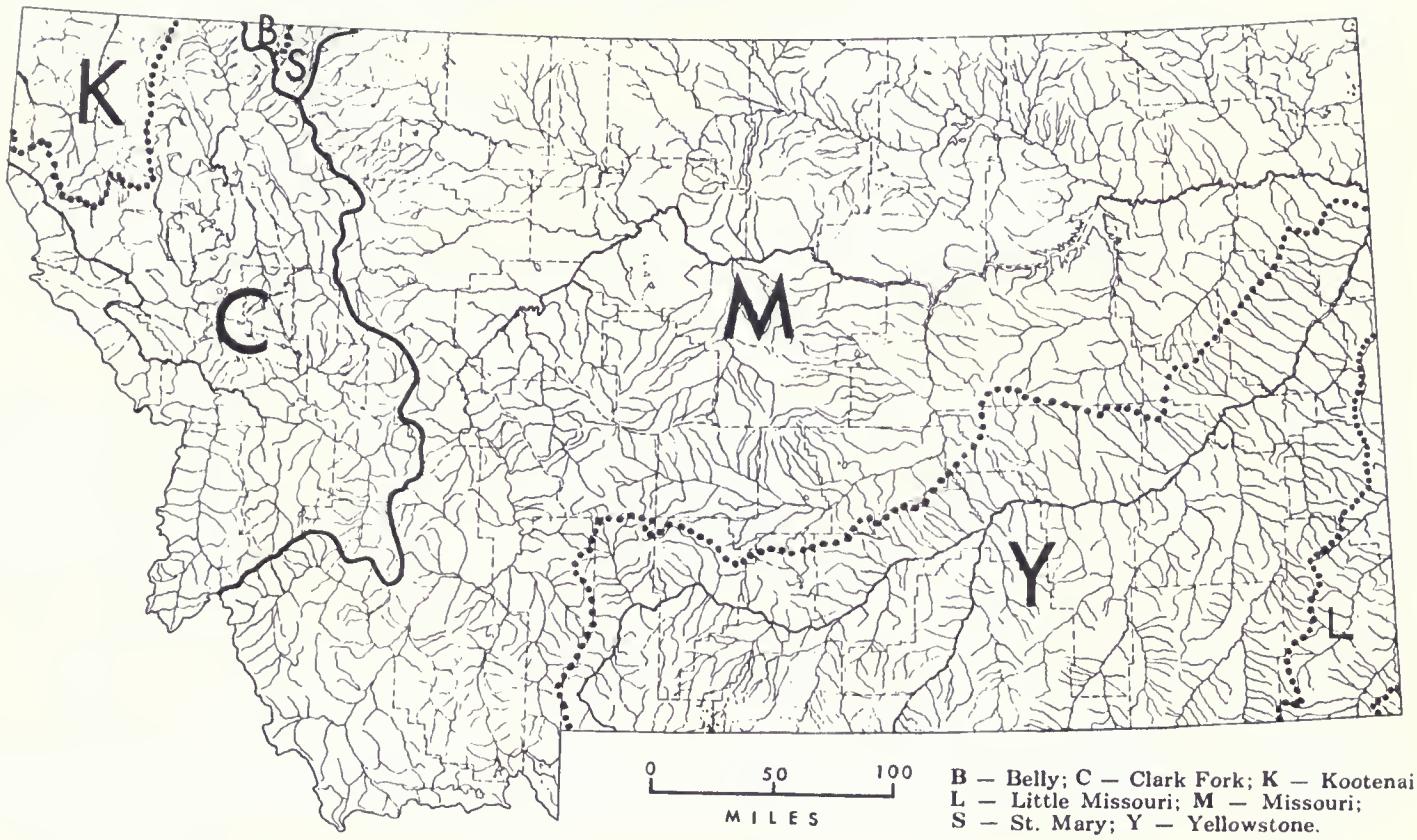
1,000,000 - 2"-6" Fish per year. 12,000 - 7-9

Rb 850,000

APPENDIX B

FISHES OF MONTANA

MONTANA — STREAM DRAINAGES



B — Belly; C — Clark Fork; K — Kootenai;
L — Little Missouri; M — Missouri;
S — St. Mary; Y — Yellowstone.

LIST OF MONTANA FISHES

FAMILY		SPECIES		DRAINAGE**						
Common name	Scientific name	Common name	Scientific name	M	Y	L	C	K	S	B
Sturgeon	Acipenseridae	White sturgeon	*Acipenser transmontanus* Richardson					x		
		Pallid sturgeon	*Scaphirhynchus albus* (Forbes and Richardson)	x	x					
		Shovelnose sturgeon	*Scaphirhynchus platorynchus* (Rafinesque)	x	x					
Paddlefish	Polyodontidae	Paddlefish	*Polyodon spathula* (Walbaum)	x	x					
Gar	Lepisosteidae	Shortnose gar	*Lepisosteus platostomus* Rafinesque	x						
Mooneye	Hiodontidae	Goldeye	*Hiodon alosoides* (Rafinesque)	x	x	x				
Trout	Salmonidae	*Lake whitefish	*Coregonus clupeaformis* (Mitchill)	x			x		x	x
		Mountain whitefish	*Prosopium williamsoni* (Girard)	x	x		x	x	x	
		Pygmy whitefish	*Prosopium coulteri* (Eigenmann and Eigenmann)				x	x		
		*Coho salmon	*Oncorhynchus kisutch* (Walbaum)	x			x			
		*Kokanee	*Oncorhynchus nerka* (Walbaum)	x	x		x	x	x	
		*Golden trout	*Salmo aguabonita* Jordan	x	x		x			
		Cutthroat trout	*Salmo clarki* Richardson	x	x		x	x	x	x
		*Rainbow trout	*Salmo gairdneri* Richardson	x	x		x	x		
		*Brown trout	*Salmo trutta* Linnaeus	x	x		x			
		*Brook trout	*Salvelinus fontinalis* (Mitchill)	x	x	x	x	x	x	x
		Dolly Varden	*Salvelinus malmo* (Walbaum)				x	x	x	
		Lake trout	*Salvelinus namaycush* (Walbaum)	x	x		x	x	x	x
		Arctic grayling	*Thymallus arcticus* (Pallas)	x	x		x		x	x
Pike	Esocidae	*Northern pike	*Esox lucius* Linnaeus	x	x		x		x	
Minnow	Cyprinidae	*Carp	*Cyprinus carpio* Linnaeus	x	x	x				
		*Goldfish	*Carassius auratus* (Linnaeus)	x	x					
		*Golden shiner	*Notemigonus crysoleucas* (Mitchill)	x	x	x				
		Pearl dace	*Semotilus margarita* (Cope)	x	x				x	
		Creek chub	*Semotilus atromaculatus* (Mitchill)		x	x				
		Northern redbelly dace	*Phoxinus eos* (Cope)	x						
		Finescale dace	*Phoxinus neogaeus* Cope	x						

FAMILY		SPECIES		DRAINAGE**						
Common name	Scientific name	Common name	Scientific name	M	Y	L	C	K	S	B
		*Utah chub	*Gila atraria* (Girard)	x						
		Flathead chub	*Hybopsis gracilis* (Richardson)	x	x	x				
		Sturgeon chub	*Hybopsis gelida* (Girard)		x					
		Lake chub	*Couesius plumbeus* (Agassiz)	x	x	x			x	
		Peamouth	*Mylocheilus caurinus* (Richardson)				x	x		
		Emerald shiner	*Notropis atherinoides* Rafinesque	x	x					
		Sand shiner	*Notropis stramineus* (Cope)		x					
		Brassy minnow	*Hybognathus hankinsoni* Hubbs	x	x	x				
		Plains minnow	*Hybognathus placitus* Girard	x	x	x				
		Silvery minnow	*Hybognathus nuchalis* Agassiz	x	x	x				
		Fathead minnow	*Pimephales promelas* Rafinesque	x	x	x	x			
		Northern squawfish	*Ptychocheilus oregonensis* (Richardson)				x	x		
		Longnose dace	*Rhinichthys cataractae* (Valenciennes)	x	x	x	x	x	x	
		Redside shiner	*Richardsonius balteatus* (Richardson)	x			x	x		
Sucker	Catostomidae	River carpsucker	*Carpiodes carpio* (Rafinesque)	x	x	x				
		Blue sucker	*Cycleptus elongatus* (LeSueur)	x	x					
		Smallmouth buffalo	*Ictiobus bubalus* (Rafinesque)	x	x					
		Bigmouth buffalo	*Ictiobus cyprinellus* (Valenciennes)	x						
		Shorthead redhorse	*Moxostoma macrolepidotum* (LeSueur)	x	x	x				
		Longnose sucker	*Catostomus catostomus* (Forster)	x	x		x	x	x	
		White sucker	*Catostomus commersoni* (Lacépède)	x	x	x			x	x
		Largescale sucker	*Catostomus macrocheilus* Girard				x	x		
		Mountain sucker	*Catostomus platyrhynchus* (Cope)	x	x					
Catfish	Ictaluridae	*Black bullhead	*Ictalurus melas* (Rafinesque)	x	x	x	x	x		
		*Yellow bullhead	*Ictalurus natalis* (LeSueur)		x		x			
		Channel catfish	*Ictalurus punctatus* (Rafinesque)	x	x	x				
		Stonecat	*Noturus flavus* Rafinesque	x	x					
Trout-perch	Percopsidae	Trout-perch	*Percopsis omiscomaycus* (Walbaum)						x	
Codfish	Gadidae	Burbot	*Lota lota* (Linnaeus)	x	x			x	x	x
Killifish	Cyprinodontidae	Plains killifish	*Fundulus kansae* Garman		x					
Livebearer	Poeciliidae	*Mosquitofish	*Gambusia affinis* (Baird and Girard)				x			
		*Shortfin molly	*Poecilia mexicana* Steindachner	x						
		*Variable platyfish	*Xiphophorus variatus* (Meek)	x			x			
		*Green swordtail	*Xiphophorus helleri* Heckel	x						
Stickleback	Gasterosteidae	Brook stickleback	*Culaea inconstans* (Kirtland)	x	x	x				
Sunfish	Centrarchidae	*Rock bass	*Ambloplites rupestris* (Rafinesque)		x					
		*Green sunfish	*Lepomis cyanellus* Rafinesque	x	x	x				
		*Pumpkinseed	*Lepomis gibbosus* (Linnaeus)	x	x		x	x		
		*Bluegill	*Lepomis macrochirus* Rafinesque	x	x					
		*Smallmouth bass	*Micropterus dolomieui* (Lacépède)				x			
		*Largemouth bass	*Micropterus salmoides* (Lacépède)	x	x		x	x		
		*White crappie	*Pomoxis annularis* Rafinesque	x	x					
		*Black crappie	*Pomoxis nigromaculatus* (LeSueur)	x	x					
Perch	Parcidae	*Yellow perch	*Perca flavescens* (Mitchill)	x	x		x	x		
		Sauger	*Stizostedion canadense* (Smith)	x	x					
		*Walleye	*Stizostedion vitreum* (Mitchill)	x	x	x				
		Iowa darter	*Etheostoma exile* (Girard)	x	x	x				
Drum	Sciaenidae	Freshwater drum	*Aplodinotus grunniens* Rafinesque	x	x					
Sculpin	Cottidae	Mottled sculpin	*Cottus bairdi* Girard	x	x				x	
		Slimy sculpin	*Cottus cognatus* Richardson				x	x		
		Torrent sculpin	*Cottus rhotheus* (Rosa Smith)					x		
		Shorthead sculpin	*Cottus confusus* Bailey and Bond				x			
		Spoonhead sculpin	*Cottus ricei* (Nelson)						x	

* Not native

** Drainage: M — Missouri; Y — Yellowstone; L — Little Missouri; C — Clark Fork; K — Kootenai; S — St. Mary; B — Belly

APPENDIX C

HOT AND WARM SPRINGS

IN MONTANA

TABLE 1 — SPRINGS, INVENTORY DATA

Spring Name	Location T	R	S	Tr.	Latitude	Longitude	Altitude (Ft.)	Topographic Map	Source of Water	Estimated Reservoir Temp. °C	Observed Temp. °C	Dates	Agency	pH	SC (μ mho/cm) @ 25° C	TDS
Alhambra	8N	3W	16	ACAA	46.4486	111.9828	4,360	Clancy 15'	Boulder batholith: See U.S.G.S. Open-File Report 78-438	96	55.6	08-23-74 09-01-72	USGS* MBMG	7.23 8.84†	929 929	660 630
Anaconda	4N	11W	13	AAA	46.1044	112.9039	5,490	Anaconda 15'	Tertiary volcanics or Madison	75	21.7	06-23-78	MBMG	7.31	2624	2310
Anderson's	3S	13E	29	ABAB	45.5530	110.1422	5,540	McLeod Basin 7.5'	Madison	30	25.0	07-25-72	MBMG	7.84	414	270
Anderson's Pasture	13S	2W	18	ACD	44.7044	111.8925	6,840	Lower Red Rock Lake 15'	Madison 2 springs	45	26.0	10-03-77	MBMG*	7.4	609	40(
Apex	5S	9W	10	AADADD	45.4203	112.6911	5,240	Glen 7.5'	Madisons	76	25.0	05-25-78	MBMG	7.78	520	340
Avon	10N	8W	24	BBC	46.6111	112.5536	4,900	Avon 15'	Tertiary volcanics, Terrace	--	25.5	06-16-78	MBMG	6.9	870	650†
Bear Creek	9S	9E	19	CAA	45.0320	110.6670	5,600	Gardiner 15'	Tertiary volcanics: Precambrian	--	24.0	05-23-78	MBMG	9.5	2700	2000†
Bearmouth 1 & 2	11N	14W	12	CD	46.7169	113.3031	3,835	Bearmouth 15'	Madison	-- 35	20.2 19.6	06-17-78 03-18-72	MBMG USGS	7.6 7.69	642 610	480† 420
Beaverhead Rock	5S	7W	22	ABBD	45.3919	112.4511	4,810	Beaverhead Rock 7.5'	Tertiary sediments over Madison (?)	--	27.0	08-21-66	MBMG	7.2	--	--
Bedford	7N	1E	23	BAAD	46.3542	111.5667	3,880	Townsend 15'	Tertiary sediments	30	23.6	06-23-78	MBMG	7.2	467	35(
Blue Joint 1	2S	23W	1	ABB	45.6973	114.3809	5,040	Painted Rocks Lake 15'	Idaho batholith: Precambrian Ravalli	45	29.0	08-11-72	MBMG	8.12†	162	145
Blue Joint 2	2S	22W	6	BAD	45.6964	111.3642	4,940	Painted Rocks Lake 15'	Idaho batholith: Precambrian Ravalli	45	29.0	08-11-72	MBMG	8.22†	180	145
Boulder	5N	4W	10	CBA	46.1981	112.0947	4,850	Boulder 15'	Boulder batholith	136	76.0	08-22-74 11-24-64	USGS* HEALTH	8.50 --	523 --	423 388
Bozeman	2S	4E	14	DDBAA	45.6608	111.1869	4,735	Bozeman 15'	Pre-Belt, Tertiary sediments	80 --	54.6	08-25-74 1964	USGS* HEALTH	8.58 --	624 --	433 428
Bridger Canyon	1S	6E	34	BCDD	45.7078	110.9750	4,890	Bozeman Pass 15'	Madison	25	20.2	--	USFWS	7.7	448	270
Broadwater	10N	4W	28	ACA	46.5958	112.1097	4,100	Helena 15'	Belt and Boulder batholith	118	62.0	08-24-74 09-17-64	USGS* HEALTH	8.53 --	796 --	596 563
Brooks	17N	18E	19	DBDBB	47.2192	109.4729	3,760	Lewistown 15'	Kootenai: Madison			08-19-64 06-12-78 09-23-75	HEALTH MBMG USGS	-- 7.33 7.68†	-- 900 882	670 680† 622
Browns	8S	9W	30	DCB	45.1047	112.7508	5,575	Dalys 7.5'	Madison: Tertiary volcanics	25 30	19.9 23.7	06-21-78	MBMG	7.4	645	480†
Camas	21N	24W	3	BBDB	47.6136	114.6672	2,830	Hot Springs 7.5'	Piegan: Diorite sill			11-24-64	MBMG	--	--	270
										100	45.0	07-03-75 09-15-75	USGS* USGS	9.39 9.11	367 394	330 274
Carter's Bridge	3S	9E	1	AADA	45.6108	110.5694	4,560	Brisbin 7.5'	Madison	40	28.0	12-22-78	MBMG	7.8†	850	600
Chico	6S	8E	1	CDCD	45.3381	110.6911	5,280	Emigrant 15'	Tertiary sediments with Tertiary granite and Madison	58	45.0	08-25-74 11-24-64	USGS* HEALTH	7.38 --	379 --	255 254
Deer Lodge Prison	6N	10W	29	BC	46.3331	112.8864	4,960	Racetrack 7.5'	Precambrian Ravalli, 4 springs	40	26.0	03-27-78	MBMG	9.3	220	170
Durfee Creek	12N	23E	19	BB	46.7933	108.8833	4,500	Roundup 1° x 2°	Madison		21.1	06-13-78	MBMG	7.25	1960	1470†
										30	--	08-15-73	MBMG	8.08†	2540	2630
Elkhorn	4S	12W	29	ACAD	45.4592	113.1069	7,200	Polaris 15'	Boulder batholith	65	48.5	08-20-74 07-27-72	USGS* MBMG	8.94 8.49†	209 219	179 180
Ennis	5S	1W	28	DCAD	45.3675	111.7256	4,920	Ennis 15'	Tertiary sediments over pre-Belt			02-06-69	HEALTH (?)	--	--	310
										129	83.2	04-01-76	USGS*	7.7	1510	1030
Gallogly	1S	19W	15	BCCCAC	45.7497	113.9400	5,400	Lost Trail Pass 7.5'	Idaho batholith		49.0	08-05-64	HEALTH	--	--	144
										56	--	08-10-72	MBMG	7.81†	202	149
											41.7	10-07-80	MBMG	9.12†	192	153
Garrison	10N	9W	19	ACB	46.6097	112.7747	4,900	Garrison 15'	Cretaceous — near Madison	35	25.0	08-08-72	MBMG	7.30†	737	530
Granite	11N	23W	7	ABDBA	Combined w/Lolo		4,180	Lolo Hot Springs 7.5'	Wallace: Idaho batholith	80	51.0	06-19-78	MBMG	9.3	280	210†
Green Springs	20N	24W	33	CBA	47.4506	114.6486	2,820	Perma 15'	Alluvium: Precambrian Piegan	--	26.0	1964 06-17-78	HEALTH MBMG	-- 9.2	-- 370	162 280†

TABLE 1 — SPRINGS, INVENTORY DATA (CONTINUED)

Spring Name	Location T	R	S	Tr.	Latitude	Longitude	Altitude (Ft.)	Topographic Map	Source of Water	Estimated Reservoir Temp. °C	Observed Temp. °C	Dates	Agency	pH	SC (μmho/cm) @ 25° C	TDS
Gregson 2 Clark Fk	3N	10W	2	BDCA	46.0433	112.8106	5,130	Anaconda 15'	Tertiary volcanics: Boulder batholith	118	70.0	08-19-74	USGS*	8.41	761	559
												04-08-65	HEALTH (?)	--	--	560
Greyson 3 Missouri	6N	2E	21	BAAA	46.2678	111.4825	3,820	Duck Creek Pass 15'	Tertiary sediments	25	17.9	06-03-78	MBMG	7.6	610	460†
Hunsaker 3 Missouri	4N	2E	32	DBDB	46.0531	111.5011	4,600	Radersburg 15'	Greyson Shale	40	24.5	06-26-79	MBMG	6.90	590	350
Hunters	1S	12E	9	CCADC	45.7572	110.2572	4,380	Hunter's Hot Springs 7.5'	Livingston: Cretaceous volcanics: Tertiary granite	78	59.0	07-02-75	USGS*	9.13	354	280
												07-25-72	MBMG	8.52†	387	280
Jackson 3 - Big Hole	5S	15W	25	CBBB	45.3677	113.4030	6,470	Jackson (Advance) 7.5'	Alluvium: Tertiary sediments: Missoula Group			08-06-64	MBMG	--	--	662
												07-28-72	MBMG	9.04†	1020	660
										125	58.0	08-16-74	USGS*	6.77	972	660
La Duke 3 Yellowstone	8S	8E	32	CDBA	45.0903	110.7733	5,280	Miner 15'	Madison	73	65.0	07-02-75	USGS*	6.52	2460	2080
												07-26-72	MBMG	7.62†	2400	2030
Landusky 1 & 2 ? Missouri	25N	24E	32	DBAD	47.8764	108.6572	3,710	Hays 7.5'	Madison: Jurassic	35	21.0	08-16-73	MBMG	8.03†	1800 (?)	1480
Landusky Plunge	24N	24E	12	CDDAB	47.8431	108.5986	3,690	Hays SE 7.5'	Madison: Jurassic	30	24.0	08-16-73	MBMG	8.09†	1262	960
Little Warm Springs 1, 2, 3 "	26N	26E	32	ACAAA	47.9692	108.3964	3,360	Bear Mountain 7.5'	Madison: Jurassic		—	08-16-73	MBMG	8.06†	2082	1750
										35	22.5	10-04-73	USGS	7.92†	1823	1540
Lodgepole 1, 2, 3 "	26N	25E	24	CABD	47.9939	108.4414	3,700	Bear Mountain 7.5'	Madison	35	30.0	10-04-73	USGS	8.0†	1430	1100
Lolo 2 - Bitterroot	11N	23W	7	ADCC	46.7253	114.5328	4,155	Lolo Hot Springs 7.5'	Wallace: Idaho batholith	83	44.0	08-17-74	USGS*	9.27	225	200
												08-09-72	MBMG	7.87†	234	200
												06-19-78	MBMG	9.6	307	230†
Lovells 3 - Beaverhead	8S	9W	28	BDBA	45.1114	112.7150	5,490	Gallagher Mountain 7.5'	Tertiary sediments: Tertiary volcanics: Madison	30	19.4	06-21-78	MBMG	7.9	620	420†
McMenomey Ranch 3 Beaverhead	9S	10W	29	AAA	45.0272	112.8444	5449	Dalys 7.5'	Madison-Beaverhead contact	30	19.0	03-24-78	PRVT.	7.4†	722	480
Medicine 2 - Bitterroot	1N	20W	12	CCA	45.8456	114.0361	4,440	Medicine Hot Springs 7.5'	Idaho batholith			08-05-64	HEALTH	--	--	170
												08-09-72	MBMG	8.08†	377	260
										82	45.0	08-16-74	USGS*	8.59	343	260
New Biltmore 3 Beaverhead	4S	7W	28	BDA	47.4620	112.4744	4,783	Beaverhead Rock 7.5'	Madison	—		08-06-64	HEALTH	--	--	2004
												07-10-72	MBMG	7.34†	2140	1780
										71	53.0	08-17-74	USGS*	6.76	2160	1860
Nimrod 2 - Clark Fork	11N	15W	14	CDAA	46.7056	113.4569	3,800	Bearmouth 15'	Cambrian: Madison			08-03-64	HEALTH	--	--	722
										30	20.5	03-18-72	USGS	7.63	856	630
												06-17-78	MBMG	7.8	860	645†
Norris 3 Madison	3S	1W	14	DAB	45.5750	111.6831	4,805	Norris 15'	Pre-Belt: Tobacco Root stock	107	52.5	08-21-74	USGS*	7.58	903	640
												11- ? -64	HEALTH	--	--	620
												05-04-70	HEALTH	--	--	700
Pipestone 1 & 2 3 Jefferson	2N	5W	28	BDDD	45.8964	112.2319	4,530	Dry Mountain 7.5'	Boulder batholith	88	57.0	08-18-74	USGS*	8.72	455	340
												08-06-64	HEALTH	--	--	328
Plunkets 3 - Missouri	4N	1E	27	AA	46.0744	111.5844	4,180	Radersburg 15'	Madison			06-02-78	MBMG	8.1	510	380†
										20	16.5	07-10-79	MBMG	7.9	400	260
Potosi 1 3 Jeff	3S	2W	7	CABA	45.5894	111.8986	6,100	Harrison 15'	Tobacco Root stock	60	49.5	08-21-74	USGS*	8.6	470	330
Potosi 2 & 3 3 Jeff	3S	2W	6	CACC	45.6017	111.9003	6,080	Harrison 15'	Tobacco Root stock	60	37.0	06-25-79	MBMG	8.36†	470	360
Pullers 3 - Ruby?	8S	5W	1	AACC	45.1714	112.1525	5,485	Metzel Ranch 7.5'	Tertiary sediments: pre-Belt	90	44.4	05-14-76	USGS*	7.7	1680	1160
Quinn's Hot Springs 1 Clark Fk	18N	25W	9	CDADA	47.3297	114.7881	2,560	Plains 15'	Precambrian Piegan			04-08-65	HEALTH	--	--	192
										99	43.4	08-09-72	MBMG	7.91†	205	190
												06-18-78	MBMG	8.9	170	130†
Renova 3 Jeffer	1N	4W	32	DBC	45.7914	112.1265	4,400	Vendome 7.5'	Cambrian, Meagher Limestone	90	50.0	08-13-76	USGS*	7.5	1100	655
Silver Star 3 - Jefferson	2S	6W	1	CCBA	45.6881	112.2942	4,700	Twin Bridges 7.5'	Boulder batholith: pre-Belt contact zone	131	71.5	08-18-74	USGS*	8.17	808	610
												07-10-72	MBMG	8.40†	847	640
Sleeping Child 2 - Bitterroot	4N	19W	7	DCDDBB	46.1053	114.0042	4,750	Deer Mountain 7.5'	Idaho batholith: 2 sources			08-04-64	HEALTH	--	--	400
												08-10-72	MBMG	7.98†	568	390
										125	52.0	08-15-74	USGS*	8.20	538	390
Sloan Cow Camp 3 Madison	12S	1E	19	CDA	44.7692	111.6500	6,560	Cliff Lake 15'	Alluvium: Pleistocene volcanics (?)	85	29.5	09-29-77	MBMG*	10.05	410	260
Staudenmeyer Ranch 3 Red Rock	13S	2W	17	CBA	44.7019	111.8775	6,750	Lower Red Rock Lake 15'	Pleistocene rhyolite, S springs: Chemistry suggests Madison source	45	28.0	10-03-77	MBMG*	7.5	646	390

TABLE 1 — SPRINGS, INVENTORY DATA (CONTINUED)

Spring Name	Location T	R	S	Tr.	Latitude	Longitude	Altitude (Ft.)	Topographic Map	Source of Water	Estimated Reservoir Temp. °C	Observed Temp. °C	Dates	Agency	pH	SC (μ mho/cm) @ 25° C	TDS
Sun River	22N	10W	26	CAB	47.6325	112.8542	4,800	Arsenic Peak 7.5'	Madison, 5 springs	35	30.4	06-15-78	MBMG	7.2	1190	890†
Targhee Sulphur	13S	4E	27	AACA	44.6769	111.2183	6,673	West Yellowstone 15'	Glacial till: volcanics	18	18.0	08-23-79	MBMG	6.69	560	370
Toston	4N	3E	6	DADC	46.1256	111.3908	3,960	Toston 15'	Madison			11-24-64	HEALTH	--	--	238
												06-02-78	MBMG	7.5	440	330†
										20	15.2	06-29-79	MBMG	7.5	440	265
Trudau	7S	4W	7	DCAD	45.2350	112.1347	5,675	Metael Ranch 7.5'	Pre-Belt and Paleozoic	45	22.7	05-25-78	MBMG	8.4	850	540
Vigilante	9S	3W	22	BDDD	45.0375	111.9508	6,200	Varney 15'	Madison	30	23.5	05-25-78	MBMG	7.5	620	400
Warm Springs State Hospital	5N	10W	24	A	46.1786	112.7942	4,820	Anaconda 15'	Boulder batholith (?) Madison (?)	79	77.0	08-19-74	USGS*	6.46	1510	1251
												04-08-65	HEALTH	--	--	1308
Warner	5N	1E	22	DBBC	46.1708	111.5856	4,100	Radersburg 15'	Alluvium: Tertiary dediments: Precambrian			06-02-78	MBMG	8.2	200	123
										23	18.0	06-16-79	MBMG	8.1	200	125
West Fork Swimming Hole	12S	1E	18	DB	44.7865	111.6450	6,700	Cliff Lake 15'	Alluvium: Pleistocene volcanics (?)	30	26.0	09-29-77	MBMG*	8.30	322	180
White Sulphur Springs	9N	7E	18	BB	46.5473	110.9039	5,025	White Sulphur Springs 7.5'	Tertiary sediments: Precambrian			09-01-61	HEALTH	--	--	1450
										125	46.0	08-17-74	USGS*	6.8	2220	1520
Wolf Creek	10S	1E	9	BBBA	44.9843	111.6151	6,100	Cliff Lake 15'	Tertiary sediments: Precambrian			09-30-77	MBMG	11.03	494	320
										77	68.0	05-13-76	USGS*	8.6	659	360

*Symbol after analysis indicates a preferred analysis, conducted for geothermal evaluation, with a field (rather than laboratory) pH measurement.
†Laboratory pH value, or TDS calculated from specific conductance data using the relationship TDS = 0.75 x SC.

TABLE 2 — SPRINGS, WATER ANALYSIS

Spring Name	Agency	Dates	Ca	Mg	Na	K	SiO_2	HCO_3	CO_3	Cl	SO_4	F	Na + K	Fe	Mn	NO_3	P	CO_2	As	B	H_2S	Li	Field pH	T.D.S.
Alhambra	USGS	04-08-76	27.	5.2	310.	17.	61.	712.	0	20.	150.	9.0	--	0.12	0.02	0.0	0.02	227.	0.036	0.41	--	0.71	7.2	660
Anaconda	MBMG	06-23-78	470.	67.	147.	10.6	22.7	439.	0	7.	1360.	2.5	--	1.21	0.48	< 0.10	--	--	--	--	--	0.25	7.0	2,310
Anderson's	MBMG	07-25-72	47.	23.	1.6	1.3	12.2	88.	0	0.5	139.	0.4	--	N.D.	N.D.	0.3	--	--	--	--	--	< .01	7.4	270
Anderson's Pasture	MBMG	10-03-77	66.5	24.	27.7	7.3	21.4	246.	0	9.7	114.	1.7	--	< .01	< .01	0.16	--	--	0.0136	0.20	<.10	0.05	7.4	400
Apex	MBMG	05-25-78	62.	16.2	23.4	3.2	19.8	140.	0	11.55	135.	0.6	--	< .01	< .01	0.92	--	--	--	--	--	--	7.6	340
Avon	MBMG	06-16-78																					6.9	650†
Bear Creek	MBMG	05-23-78																					9.5	2,000†
Bearmouth 1 & 2	USGS	03-18-72	89.	28.	7.6	1.8	16.	220.	0	1.5	163.	0.5	--	0.03	0.01	0.2	--	--	--	--	--	--	7.5	420
Beaverhead Rock	MBMG	08-21-66																					7.2	--
Bedford	HEALTH	12-09-64	57.	22.	--	--	--	155.	0	9.	103.	0.7	8.	--	--	0.9	--	--	--	--	--	--	7.2	350†
Blue Joint 1 & 2	MBMG	08-11-72	2.6	0.1	37.5	0.34	54.	67.	0	3.1	4.8	9.5	--	N.D.	N.D.	N.D.	--	--	--	--	--	--	8.2	145
Boulder	USGS	08-22-74	2.2	< .1	120.	3.8	110.	161.	4.	19.	74.	11.	--	0.02	< 0.02	--	--	--	--	0.56	--	0.24	8.5	420
Bozeman	USGS	08-25-74	9.5	2.7	120.	2.8	66.	130.	3.	46.	110.	9.2	--	0.02	0.02	--	--	0.5	--	0.20	0.6	0.04	8.6	430
Bridger Canyon	USFW	--	54.8	22.7	4.26	1.4	8.2	209.	0	0.19	80.	0.47	--	< .025	0.0015	0.05	--	--	--	--	--	--	7.7	270
Broadwater	USGS	08-24-74	11.	0.9	160.	5.8	98.	210.	5.	33.	170.	9.4	--	0.07	0.05	--	--	1.1	--	0.80	< .5	0.48	8.5	600
Brooks	USGS	09-23-75	133.	40.3	3.4	1.4	8.9	195.2	0	0.95	336.	1.3	--	< .01	< .01	3.60	--	--	--	--	--	--	7.3	620
Browns	MBMG																						7.4	480†
Camas	USGS	09-15-75	1.12	.39	83.	1.8	58.0	112.2	19.2	5.50	43.7	5.7	--	<.01	< .01	1.20	--	--	--	--	--	--	9.1*	270
Carter's Bridge	MBMG	12-22-78	129.	35.4	7.3	4.1	19.4	187.	0	3.2	307.	1.3	--	< .01	0.01	0.57	--	--	0.0011	0.11	--	0.03	7.8*	600
Chico	USGS	08-25-74	35.	8.8	35.	6.8	34.	170.	<1.	10.	41.	0.9	--	< .02	< .02	--	--	11.	--	0.06	0.6	0.03	7.4	250
Deer Lodge Prison	MBMG	03-27-78	3.9	0.1	45.8	0.5	45.8	40.9	12.5	2.55	33.	7.5	--	<.01	< .01	0.51	--	--	--	--	--	0.07	9.3	170
Durfee Creek	MBMG	08-15-73	533.	165.	14.0	3.2	12.8	59.	0	4.1	1872.	1.8	--	0.09	0.02	0	--	--	--	--	--	0.04	7.2	2,630
Elkhorn	USGS	08-20-74	1.9	< .1	48.	0.7	55.	77.	4.	1.7	27.	2.6	--	< .02	< .02	--	--	0.02	--	0.04	0.9	0.05	8.9	180
Ennis	USGS	04-01-76	5.8	0.6	340.	17.	96.	442.	0	120.	220.	11.	--	0.02	0.01	--	0.02	14.	0.025	0.61	--	0.26	7.7	1,030
Gallogly	MBMG	10-07-80	3.0	< .1	42.8	0.7	43.7	63.7	12.2	1.2	12.1	5.8	--	0.005	<.001	0.04	--	--	0.0008	0.05	--	0.09	9.1*	150
Garrison	MBMG	08-08-72	77.	35.	24.	5.2	18.2	59.	0	3.4	335.	1.3	--	N.D.	N.D.	0.2	--	--	--	--	--	0.15	7.1	530
Granite	MBMG																						9.3	210†

TABLE 2 — SPRINGS. WATER ANALYSIS (CONTINUED)

Spring Name	Agency	Dates	Ca	Mg	Na	K	SiO_2	HCO_3	CO_3	Cl	SO_4	F	Na + K	Fe	Mn	NO_3	P	CO_2	As	B	H_2S	Li	Field pH	T.D.S.
Green Springs	HEALTH	01-05-65	N.D.	N.D.	--	--	--	101.	12.	5.	18.	2.2	61.	0.14	--	N.D.	--	--	--	--	--	--	9.2	280†
Gregson	USGS	08-19-74	3.9	< .1	170.	3.9	85.	160.	3.	17.	180.	18.	—	< .02	< .02	—	—	1.1	--	0.30	1.6	0.64	8.4	560
Greyson	MBMG																						7.6	460†
Hunsaker	MBMG	06-26-79	71.2	18.8	22.3	11.4	23.3	325.	0	11.	30.	0.75	—	0.58	0.20	0.18	--	--	0.0034	0.10	--	0.019	6.9	350
Hunters	USGS	07-02-75	< 1.0	< .1	85.	0.6	65.	170.	15.	18.	11.	5.6	--	< .02	< .02	—	—	0.3	--	0.67	5.3	0.03	9.1	280
Jackson	USGS	08-16-74	10.	3.7	240.	10.	52.	610.	< 1.	7.7	45.	2.0	--	< .02	0.04	--	—	155.	--	0.83	0.6	0.32	6.8	660
La Duke	USGS	07-02-75	320.	58.	230.	23.	49.	300.	< 1.	45.	1200.	3.6	--	0.16	0.02	--	—	152.	--	0.46	< 1.0	0.24	6.5	2,080
Landusky 1 & 2	MBMG	08-16-73	266.	86.	39.	9.	18.2	109.	0	18.8	982.	1.5	--	N.D.	N.D.	1.1	--	--	--	--	--	0.09	8.0*	1,480
Landusky Plunge	MBMG	08-16-73	161.	65.	24.	6.7	17.8	101.	0	9.5	620.	1.6	--	N.D.	N.D.	1.1	--	--	--	--	--	0.05	8.1*	960
Little Warm Springs 1, 2, 3	MBMG	08-16-73	289.	110.	72.	13.3	16.	101.	0	59.	1144.	1.4	--	0.10	N.D.	0.1	--	--	--	--	--	0.14	8.1*	1,750
Lodgepole 1, 2, 3	MBMG	08-16-73	268.	96.	75.	13.	16.3	81.	0	57.	1062.	1.1	--	N.D.	N.D.	0.1	--	--	--	--	--	0.14	8.1*	1,630
Lolo	USGS	08-15-74	1.8	< .1	52.	1.2	72.	70.	8.	6.1	18.	6.4	--	< .02	< .02	—	—	0.1	--	0.11	< .5	0.03	9.3	200
Lovells	MBMG																						7.3*	420†
McMenomey Ranch	PRVT.	03-24-78	88.	27.5	28.3	4.5	17.5	217.	0	16.15	191.	0.7	--	< .01	< .01	0.67	.134	--	0.0145	--	--	0.04	7.4*	480
Medicine	USGS	08-16-74	1.9	< .1	80.	1.4	60.	120.	3.	6.7	33.	14.	—	< .02	< .02	—	—	0.5	--	0.12	0.6	0.20	8.6	260
New Biltmore	USGS	08-17-74	290.	73.	160.	24.	46.	230.	< 1.	46.	1100.	3.3	--	0.10	0.03	--	—	58.	--	0.92	1.1	0.18	6.8	1,860
Nimrod	USGS	03-18-72	126.	36.	15.5	3.4	21.	168.	0	2.7	340.	0.8	--	0.01	0.01	0.4	--	--	--	--	--	--	7.7	630
Norris	USGS	08-21-74	17.	3.2	180.	10.	88.	380.	1.	23.	130.	7.4	--	0.02	0.02	—	—	15.	--	0.10	< 1.0	0.09	7.6	640
Pipestone 1 & 2	USGS	08-18-74	2.6	< .1	98.	1.9	66.	100.	4.	20.	94.	5.3	--	< .02	< .02	—	—	0.3	--	0.28	2.3	0.09	8.7	340
Plunkets	MBMG	07-17-79	38.5	23.5	22.4	2.4	15.5	87.2	16.2	9.0	87.	0.7	—	< .002	< .002	3.05	—	--	0.0017	.11	--	0.032	7.8	260
Potosi 1	USGS	08-21-74	10.	< .1	91.	1.6	46.	63.	2.	5.9	140.	6.2	—	< .02	< .02	—	—	0.3	--	< .02	< .5	0.05	8.6	330
Potosi 2 & 3	MBMG	06-25-79	13.2	0.1	94.6	1.7	47.7	67.3	0	6.	170.	6.1	—	0.01	< .01	< .10	--	--	--	0.03	--	0.056	8.4*	360
Pullers	USGS	05-14-76	56.	19.	330.	24.	33.	511.	0	91.	350.	2.2	—	0.04	--	0	0	16.	0.034	0.69	--	0.19	7.7	1,160
Quinn's Hot Springs	MBMG	08-09-72	3.6	0.2	39.2	1.5	76.6	71.	0	3.1	29.	2.1	--	N.D.	N.D.	N.D.	--	--	--	--	--	0.01	8.9	190
Renova	USGS	08-13-76	51.	13.	150.	13.	37.	310.	0	34.	200.	3.0	--	0.08	0.03	—	0.03	14.	0.019	0.48	--	0.13	7.5	650
Silver Star	USGS	08-18-74	9.3	0.3	170.	6.4	110.	170.	2.	31.	190.	8.7	—	< .02	0.02	—	—	1.8	--	0.25	1.0	0.34	8.2	610
Sleeping Child	USGS	08-15-74	5.4	< .1	120.	2.9	66.	170.	2.	9.5	87.	15.	—	< .02	< .02	—	—	1.8	--	0.35	0.8	0.18	8.2	390
Sloan Cow Camp	MBMG	09-29-77	0.9	0.1	88.	1.1	50.9	64.2	74.4	7.65	3.7	3.1	--	0.17	< .01	0.22	—	--	0.002	0.16	0.94	0.01	10.0	260
Staudenmeyer Ranch	MBMG	10-03-77	68.	24.	29.	7.7	21.4	251.	0	9.35	116.	1.8	--	< .01	< .01	0.22	—	--	0.0154	0.23	< .10	0.05	7.6	390
Sun River	MBMG																						7.2	890†
Targhee Sulphur	MBMG	08-23-79	72.9	27.5	7.1	4.5	14.4	63.3	0	1.7	156.	1.1	--	0.01	0.02	--	—	--	0.0151	0.06	--	0.03	6.7	320
Toston	MBMG	06-29-79	48.7	20.2	13.6	3.6	19.8	193.	0	6.8	56.6	0.70	--	< .01	< .01	1.68	—	--	--	0.12	--	0.047	7.5	240
Trudau	MBMG	05-25-76	78.	30.	70.	11.1	19.0	425.	0	18.20	102.	0.8	--	< .01	< .01	0.77	—	--	--	--	--	--	8.4	540
Vigilante	MBMG	05-24-78	84.5	27.	6.7	3.1	15.5	182.	0	1.90	174.	0.9	--	0.01	0.01	0.67	--	--	--	--	--	--	7.5	400
Warm Springs State Hospital	USGS	08-19-74	220.	22.	120.	26.	56.	260.	< 1.	5.0	670.	3.9	--	0.05	0.05	--	--	132.	--	0.10	0.7	0.36	6.5	1,250
Warner	MBMG	06-16-79	25.8	7.2	5.3	0.8	17.1	101.	0.6	1.8	16.4	0.2	--	0.01	< .01	0.97	—	--	0.0009	< .02	--	0.005	8.2	125
West Fork Swimming Hole	MBMG	09-29-77	19.	29.	4.8	1.9	13.7	194.	0	2.75	11.8	0.4	--	< .01	< .01	0.44	—	--	0.0028	0.02	0.17	0.01	8.3	180
White Sulphur Springs	USGS	08-24-74	44.	12.	480.	20.	51.	830.	< 1.	180.	310.	7.4	--	0.11	0.15	--	—	420.	--	9.10	0.7	1.30	6.5	1,530
Wolf Creek	MBMG	09-30-77	8.7	1.6	100.	1.8	50.3	154.	7.3	19.4	42.6	16.	—	< .01	< .01	0.28	--	--	0.005	0.03	0.2	0.07	8.6*	320

All water quality information is in milligrams per liter (mg/L)

Symbol explanations:

-- — Not determined.

N.D. — Not detected, detection limit not known.

* — Laboratory pH.

† — Laboratory value for TDS calculated from specific conductance data using the relationship TDS = 0.75 x SC.

APPENDIX D

List of Spring Creeks

with a flow of less than 5 cfs

OR

Need to be inventoried

Table 1. Spring creeks in Montana not included in the inventory and needing investigation.

Region 2

Spring creek in Flint Creek drainage near Phillipsburg, Montana
Spring creek near Drummond, Montana
Spring creek in Rock Creek drainage east of Missoula, Montana

Region 3

Spring creek in Big Hole River near Wise River, Montana
Bull Run and Hess spring creeks in E. Gallatin Drainage
Gordon Springs in the Beaverhead River drainage
Spring creek above Clark Canyon Reservoir in Beaverhead River drainage

Table 2. Spring creeks in Montana with flows of less than 5 cfs

Name	Drainage	Legal Description (At Mouth)
Region 1		
Spring Creek	Flathead	T28N, R23W, Sec.24
Spring Creek	Flathead	T28N, R21W, Sec.07
Spring Creek	Flathead	T28N, R22W, Sec.12
Somers Hatchery Creek	Flathead	T26N, R21W, Sec.28
Sullivan Spring Creek	Flathead	T24N, R24W,
Region 2		
Chamberlain Creek	Blackfoot River	T14N, R13W, Sec. 20
Dry Cottonwood Creek	Nevada Creek	T12N, R11W, Sec. 14
Wales Creek	Blackfoot River	T13N, R13W, Sec. 12
Wet Cottonwood Creek	Nevada Creek	T12N, R10W, Sec. 31
Gallagher Creek	Clark Fork	T11N, R09W, Sec. 06
Liverpool Creek	Blackfoot River	T05N, R06W.
Rock Creek Springs	Clark Fork	T11N, R17W, Sec. 12
Nimrod Springs	Clark Fork	T11N, R15W, Sec. 14
Region 3		
Beaverhead Rock Springs	Beaverhead River	T05S, R07W, Sec. 22
White Rock Springs	Jefferson River	T01S, R05W, Sec. 26
Sappington Springs	Jefferson River	T01S, R01W, Sec. 33